No End to Discovery

Robert Beauford [from: *Meteorite* magazine, November 2011, Volume 17, No. 4, pp. 4-5]

Everything that surrounds us was once a meteor, and every object contains traces of its extra-terrestrial origins. From the ratios of elements in the earth to its predominant isotopes and overall mineral abundances, we live on a world not substantially unlike any differentiated asteroid, and only slightly removed from our chondritic progenitors. If the earth were smashed to pieces and thoroughly mixed up in a pestle by a hypothetical researcher of vast proportions, you would find it difficult to tell that the crucible's contents were not chondritic in origin. Chemical and mechanical terrestrialization and planetary differentiation do not fundamentally change our overall composition. They merely sort things out and recombine them. Even we, ourselves, are essentially meteoric in origin, though we are definitely end-members of the terrestrial weathering and sorting processes.

The vast majority of the Earth's mass accumulated during the first few hundred million years of solar system history. To say that the process was violent would be an understatement. The starry sky may have looked radically different during Earth's earliest history, viewed through a superheated atmosphere occasionally composed, at its most violent intervals, of silicate vapor. This alien sky stretched above a planetary surface of super-critical lavas sloshing in violent tides on a far more rapidly spinning ball. A rich image, and perhaps one that was true only after such atrocities as the lunar forming impact, but regardless - the world was pummeled constantly. In all, almost 6 trillion-trillion kilograms of meteorites impacted the earth, most of them within a relatively short span.

Today, things have calmed. What was once a violent constant is now a punctuated trickle. But bombardment has only slowed, not ceased. The earth is growing by something around 100 million kilograms each year, plus or minus an order of magnitude, depending upon who you ask. This constant accumulation varies slightly over time as the remaining dust and loose debris in the solar system is slowly swept up. The remainder will not be consumed within the life of the solar system, however, so there will always be meteorites.

Why am I pointing this out? A customer who was recently in my store, upon spying the meteorites, commented that he had dreamed of searching for meteorites for years, but had never pursued it because he presumed that all of the strewnfields had been searched to exhaustion. A few days later, I was a chance observer in a conversation in which the Sahara desert was proclaimed 'hunted out.' The view, in both cases, was that the golden age of meteorite finds was at an end, and that future generations would inherit a pre-searched world, bereft of all but crumbs and remnants… or a 'cherry picked lot' in the parlance of my trade as a jeweler, in which all of the easiest material had already been easily picked up by those who had come before.

Back, again, to the nature of rocks. We not only count the age of rocks, but also name them from the moment they were last destroyed. By destroyed, I mean a variety of things, ranging from being chemically attacked and reformed to being physically demolished, melted, or some combination of these. This can mean chemical change, as in the weathering of meteorites, melting, as in the subduction of giant slabs of the many times reprocessed meteoric material that we call continents, or mechanical crushing combined with these two as in the case of a meteorite sadly (to our eyes) obliterated and reduced to a trail of fine impact dust, ablation spherules from condensed vapor, and CO2 and other atmospheric gasses, all produced when a meteor is burned away before reaching Earth's surface.

Every rock, every plant, soil, and even our bodies are composed of the weathered remnants of strewnfields and of the debris of failed atmospheric impactors. What we call a meteorite is a brief moment in the history of a rock. It is an object that has joined the ranks of our rocks and soil and growing things, but has not yet weather to become, like all who came before, unrecognizable from its surroundings. Consider: Not only is everything around us composed of meteorites (albeit weathered far beyond the bounds of the definition), but every bucket of soil contains microscopic remnants of unweathered material. Every mile of yards and gardens contains debris visible to the eye. Every spot on the planet is underlain by craters, whether still visible in the rock or not, and by layers of proximal and distal eject blankets from impactors. Everywhere we walk is crossed by overlapping strewnfields.

Are they easy to find? Of course not, but let me conclude with one of the more inspiring pieces of math that I know, and the reason that I began this brief essay. This is what I told the customer who thought there was little or nothing left to find.

The area of an ellipse is determined by the equation πab, where a and b are one-half of the ellipse's major and minor axes. Now, taking a fairly ordinary strewnfield, the March, 1960, Bruderheim, Canada, let's do the math. According to Folinsbee and Bayrock, 1961, the strewnfield measures about 5.6 by 3.6 kilometers. This yields an area of a little over 15.8 square kilometers. Assuming a meteorite hunter could cover 1/2 kilometer per hour with a rigorous metal detector and visual search, pausing to dig on occasion, and assuming that a searcher could cover an area about 1 meter in width with their metal detector as they proceeded, it would take an individual, working 40 hours per week with a 2 week vacation each year, almost 16 years to search the strewnfield even once… and they would still only find what fell beneath their eyes, instrumentation, and focused attention.

This is only one strewnfield. What percentage of the world's strewnfields we have so far discovered, I cannot say, but I suspect the number is vanishingly small. New ones are found every year, and those willing to search them are a rare breed. By the simplest of math, it would be incredibly bold to say that we have found 1% or even $1/100^{th}$ of 1% of the world's meteorites. It would be bolder yet to say that we have found more than a tiny fraction of even the world's most obvious strewnfields. Most would not recognize one in their own back yard. Of those who could, we might walk across one for a week or for years before realizing that we are within one. Eyes that are capable of comprehending that a strewnfield is present have only looked… really looked - with focused attention, at such a small percentage of the Earth's surface that the percentage is mathematically insignificant.

Not only have we not searched out the world's strewnfields, we have barely touched them. The discovery is not over. We have barely begun. Those who have come before have only shown what is possible and what to look for. No one has or can, except in the most limited and localized sense, 'search out' even the world's smallest strewnfields, much less its deserts, dry lakes, ice sheets, and back yards. The world is not now, and never will be 'cherry picked.' For those who dare and dream to explore, it is ripe with opportunity.

And so, on behalf of Derek and Hazel Sears, myself, and all of the people that support Meteorite magazine, we welcome you to the November issue, we are honored to share what you discover, and we encourage you to continue searching.

References:

Folinsbee, R.E. and Bayrock, L.A. (1961) The Bruderheim meteorite - fall and recovery, *Journal of the Royal Astronomical Society of Canada*, Vol. 55, pp. 218-228.

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