

The Fractal Dimension of Surprise

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What is fractal dimensionality, and how does it relate to literature? What traits do the works of Roger Zelazny, master fantasist, and Raymond Chandler, king of hard-boiled noir fiction, share in common? And what can those similarities teach us about the craft of storytelling? A common characteristic in the works of beginning and early career writers is the desire to create "plotty" stories that trick the reader with unforeseen twists. But the mastery of craft doesn't begin from the top down. Instead, it's grown from the bottom up: from paragraphs, sentences, even the author's choice of individual words. And it's at this scale, the micro level, where intriguing, surprising stories are born.

I'd like to begin by thanking Dr. Donovan and the UNM Hobbit Society for the invitation to participate in this year's Intellectual Hooliganism colloquium. I'm honored to be a part of this, and I'm enjoying the panel presentations quite a bit. Thank you, sincerely, for having me.

Now. Rather than presenting myself as somebody with a surfeit of wisdom and experience to bestow, I'd like to share -- as a fellow traveler -- some ideas that I've been mulling for a while. I'll present an unfinished hypothesis, if you will, because these thoughts are still crystallizing. Nevertheless I believe there are insights to be gained from these musings.

I'm going to start by talking about mathematics. But bear with me. I will bring it back to literature.

In 1967, the Polish/French/American mathematician Benoit Mandelbrot published, in the journal *Science*, a paper titled, "How Long is the Coast of Britain? Statistical Self-Similarity and Fractional Dimension." Mandelbrot is perhaps best known to us now as the namesake of the eponymous, or perhaps infamous, Mandelbrot Set: that infinitely fascinating, infinitely zoomable alien blob that rules over the esoteric realm of fractal mathematics. But this paper marked one of his earliest forays into the study of fractal geometry, and in fact it appeared several years before he coined the term "fractal". The paper outlines his thoughts regarding an old idea that mathematicians had been kicking around for a long time: the concept of a fractional dimension (sometimes also known as the Hausdorff dimension).

We're all familiar with the idea of dimensionality. A piece of string, say, is essentially one-dimensional because it has a single dimension: length. A piece of paper is essentially two-dimensional because it has length and width. So is the humble narrator of *Flatland*, who happens to be a sentient square. This table, say, is three dimensional, because it has finite length, width, and depth. (I'm cheating a bit with the string and the paper; if I wanted to be rigorous I'd say "line" and "plane". But

I think you get my point.) But it turns out that there are objects in nature whose dimension is not an integer--not simply 1, 2, or 3. (Or 4, or 5, or...)

Here's an example by way of a thought experiment. Take a one-dimensional piece of string. One could imagine warping and tangling it, folding it back on itself again and again until it begins to fill space, until it assumes finite extent in 2 or even 3 dimensions. Is it still a one-dimensional object at that point? Or is its dimensionality something more than 1 yet less than 2? We could do the same with a piece of paper. If we crumple it, it becomes a 2-dimensional object with finite extent in 3 dimensions. Its dimensionality is something between 2 and 3. That's what a non-integer fractal dimension indicates. And this turns out to be a useful concept in mathematics.

A coastline happens to be another object with a non-integral fractal dimension. Mandelbrot's paper picked up on an earlier observation by Lewis Fry Richardson, who had noted that the measured length of a coastline or geographical border increases as the unit of measurement decreases. If you were to measure the coastline of Britain with a hundred-mile-long measuring stick, walking it around the coast as closely as possible, you'd get one answer; if you measured it by laying down a succession of 10-mile

sticks, you'd get a different, and larger, answer because the path you traced through space would be more curvilinear. Going still further, you could imagine shrinking your measuring stick to the size of a grain of sand; the coastline you traced with it would be so rife with twists, turns, and reversals that it would contain practically no straight segments at all. Your answer for the length of the coastline would be larger still. The intriguing mathematical oddity here is that the measurement appears to increase without bound as the unit of measurement gets smaller and smaller.

Why is this?

The culprit is called **self-similarity**. An object is said to be self-similar if its overall structure can be seen repeated within itself at smaller and smaller scales. The string is a trivial example: a long string is made up of nearly identical bits of shorter string. A uniform cube can be divided into a bunch of smaller identical cubes. The Mandelbrot set is famous because you can find smaller versions of the characteristic blob embedded at smaller and smaller scales. And if you were to imagine floating in space hundreds of miles above Great Britain, and then you zoomed in on a particularly crinkly bit of coastline, you'd find that the crinkles contained crinkles. And, if you

kept zooming, you'd find that those crinkles contained still more crinkles, and so on and so forth, on and on and on. Similarly with our crumpled piece of paper: it contains creases upon creases upon creases. Not forever, of course, because the material world is not infinitely divisible -- it's made of atoms. (But that's okay. So are stories. Which I'll get to in a moment.)

This is seen frequently in nature. River networks, fault lines, coastlines, mountain ranges, Romanesco broccoli, clouds, snowflakes, ocean waves, and even the circulatory system inside your own body: all exhibit an approximate form of self-similarity to greater or lesser degrees. (And in fact, computer modelers sometimes make use of fractals to generate eerily realistic synthetic landscapes.) Self-similarity is also an important concept in physics. For example, the evolution of a supernova blast wave propagating through a molecular cloud can be described in terms of self-similarity. And it's the self-similarity of an object, such as a coastline, that gives rise to its fractal dimension. (Remember the folded string, or the crumpled paper.)

So. I'll argue here, today, that self-similarity -- of a particular type -- can be a great thing for storytelling, too. I recently had a revelation when I

realized that some of the work I enjoy reading most could be thought of as embodying a noninteger fractal dimension. Though I'm still processing this, it was a watershed moment in my writing. Let me try to explain.

We all enjoy stories that take us to unexpected places. That's one of the many reasons why we read. But when it comes to fiction, I think we tend to overestimate the importance of large-scale, structural surprises. The solution to the murder mystery that nobody anticipates. Or the unforeseen twist ending. But I'm convinced that we're fixating on the wrong things. (In another medium, film, the director M. Night Shyamalan has tried to build a career by replicating the singularly successful conclusion to his film *The Sixth Sense*. And, to my mind, that has hampered his work, to the extent that he's becoming a parody of himself. A truly successful twist ending is quite a rare thing.) When we fixate only on the big picture, we're looking at the map, the entire island of Great Britain, when we should be looking at the grains of sand along the beach. We should focus our attention not just at the big picture, but at the smallest scale-- at the atoms of story. The words and sentences.

One thing that we writers are taught, and correctly so, is to remove clichés from our writing. And what is a

cliché? A cliché is an idea or expression so overused that a reader can anticipate exactly where it's going. At one end of the scale, plots can be clichéd. (There's a reason many short fiction venues maintain lists of story concepts they will NOT accept. The stranded astronauts who become Adam and Eve are a notorious example of an overused plot. I'm looking at you, Battlestar Galactica.) At the opposite end of the scale, sentences can be clichéd, too. A clichéd sentence contains a turn of phrase so common and familiar that an attentive reader could stop reading and recite the rest of it. Something becomes a cliché when it's drained of all power to surprise or delight.

Consider the opening to Roger Zelazny's story, "King Solomon's Ring:"

King Solomon had a ring, and so did the
guy I have to tell you about.
Solomon's was a big iron thing with a
pentagram for a face, but Billy
Scarle's was invisible because. . .

Well, because why? Excluding those of you who already know the story, how do you think that sentence ends? Any predictions? OK. Here's the answer.

King Solomon had a ring, and so did the
guy I have to tell you about.
Solomon's was a big iron thing with a
pentagram for a face, but Billy
Scarle's was invisible because he wore
it around his mind.

Did anybody predict that? I'd argue this is not a clichéd opening, quite the opposite, because it's hard to anticipate the next crinkle in the coastline. Let's try another one. Zelazny's Hugo-award winning novel, *Lord of Light*, starts like this:

His followers called him Mahasamatman,
and said he was a god. He preferred. . .

Again, don't cheat if you already know the answer-- he preferred *what*? Try to predict where that line is going.

His followers called him Mahasamatman,
and said he was a god. He preferred to
drop the Maha- and the - atman,
however, and called himself Sam.

The point I'm trying to make is that the uniqueness and creativity of the overall story isn't reserved for a handful of plot twists, or even for the succession of eyeball kicks in the worldbuilding. It's present at the lowest level of the storytelling. It resides in the atoms, or, if you prefer, the grains of sand. Zelazny's prose was surprising at multiple levels: word choice, sentence structure, worldbuilding, plot. In that way, *Lord of Light* and *King Solomon's Ring* are internally self-similar; they have a nontrivial fractional dimension. In *Lord of Light*, for instance, the surprising wordplay tells a story that begins as a mythic fantasy with warring gods but which, we

soon learn, is really about technologically advanced beings *playing* at godhood. What's presented at first as fantasy becomes science fiction, or science fantasy.

It's that high-concept worldbuilding which makes *Lord of Light* a good book. But it's the craftsmanship at the lowest level, the atomic level, that makes it one of the all-time great science fiction novels. All in my humble opinion, of course.

Notice, too, that when I say a piece of writing exhibits self-similarity, that's not the same as saying it's repetitive or monotonous. It means the writing has an interesting texture at multiple levels. Like a coastline, it's crinkly at large, medium, and small scales. It has a noninteger fractal dimension because the vocabulary, the sentence structure, theme, and plot are all reflected in one another. Not all writing works like this. But it's a pretty neat thing when it does.

Consider Bob Shaw's classic and haunting science fiction short story, "The Light of Other Days." If you're not familiar with it, do yourself a favor! It's a very quick read, just a few pages long, but packed with emotion. Here's the first line:

Leaving the village behind, we followed
the heady sweeps of the road up into a
land of slow glass.

What follows is a story of loss and longing: loss of freedom to roam, loss of home, longing to be free of family, longing to recover family. The physical details of the setting, of the slow glass harvester and his cottage, become an inverted mirror reflecting the emotional turmoil between the narrator and his wife. The theme and setting are self-similar, because a version of one can be found within the other. I won't say any more about the details of this story because I'd hate to ruin it for you, suffice it to say the emotional and thematic resonances together deliver a powerful punch.

This self-similar craftiness isn't restricted to genre fiction. Raymond Chandler, author of the Philip Marlowe detective novels, had a rather low opinion of science fiction, as a matter of fact. But his prose crackles like Zelazny's in a similar way. He didn't rely on his mystery plots to do the heavy lifting. Instead, Chandler established himself as one of the great American writers on the virtue of his sentence-level craft. It's just as crinkly as the coastline of England.

For instance, here's a line from the opening pages of *Farewell, My Lovely*. This is Philip Marlowe's first

impression when he meets an ex-con with the wonderful name

Moose Malloy:

Even on Central Avenue, not the
quietest dressed street in the world,
he looked about as inconspicuous as...

As inconspicuous as what? Any guesses? Here's the
answer:

...he looked about as inconspicuous as
a tarantula on a slice of angel food.

Isn't that fantastic? And by the way if you think
about how that sentence works, it's doing double duty --
it's practically self-similar because it tells you just as
much about the narrator as it does about Moose Malloy.

The Philip Marlowe novels were a revelation to me.
They're chockablock with descriptions that are perfect yet
utterly unpredictable. Here are some more:

She was the kind of blond that could
make a bishop kick a hole in a stained-
glass window.

And my personal favorite:

She gave him a look that should have
stuck four inches from his back.

Such wonderful hard-boiled poetry. Again, the point
I'm trying to make is that Chandler established himself as
a master craftsman not through plot or characterization
(though some of his setting descriptions are pure poetry),
but through his sentence-level work. The Philip Marlowe

novels are self-similar because they contain surprises at every single level: sentence, scene, and plot. (Although after you've read a few, the plots become less surprising. Nor does the characterization provide many surprises: his characters, particularly women, fall into a limited set of categories that get recycled from book to book. This is characteristic of noir fiction.) Recall that Chandler was famous for his somewhat-cynical advice for countering writer's block: if you're uncertain what should happen next, have somebody burst in wielding a gun. (Or, if you're Tim Powers, instead of a gun-wielding thug, it's a clown on stilts with his hair on fire. He actually does that in *The Anubis Gates*.) By which they meant to recommend adding another complication; another crinkle to the coastline.

I mentioned the films of M. Night Shyamalan earlier. I said that the twist ending of *The Sixth Sense* was more successful than the attempted surprises in some of his later films. Why? By "successful" I'm not really referring to how many people did or didn't anticipate the final revelation. I'm talking more about the structure of the film that supports that final revelation. A truly good surprise is one that makes you say, "Oh! Of course! I didn't see that coming... but I could have." Because all

the information the audience needs is present throughout the story -- it's embedded in clues sprinkled from beginning to end. In fact, truly excellent storytelling sometimes contains a reflection of the conclusion in the beginning. In other words, it's self-similar. The clues sprinkled through a mystery are self-similar reflections of the overarching idea.

I'm not saying that we should strive to craft impenetrably complex Mandelbrot Set-stories. That wouldn't do any good. Rather, there's a lot to be gained from contemplating the shape of a tale at every scale. How you tell a story is just as important as what story you're telling. The atoms are just as important as the coastline.

Don't follow in the mold of M. Night Shyamalan. Instead, examine your storytelling as if you were Raymond Chandler, Roger Zelazny, or Benoit Mandelbrot.