

# Social Crystallization

by *Jess H. Brewer*

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Randy’s “MINERALOGUES” uses minerals as media and metaphors. Rather than quibble about some of the technical malapropisms and mistakes therein, I would like to take one of her metaphors, namely *crystallization*, and “run with it” to the best of my ability.

Crystallization is a particularly apt form of Emergence in Physics, because the individual components of a crystal (atoms) are pretty simple and demonstrably identical, containing in their individual properties no hint of the orderly arrangement they exhibit when assembled into a crystal.

Crystals are also a near-perfect metaphor for social phenomena such as art, literature, memes and politics, in which chaotic interactions of humans self-assemble into surprisingly coherent group behaviour. So I want to play with that particular idea.

It’s tempting to imagine a crystal being “constructed” by some high-tech version of Maxwell’s Demon, intentionally emplacing each atom in its proper lattice site with some sort of nano-tweezers, like the 35 xenon atoms spelling out “IBM” on a freshly-cleaved surface of a nickel crystal.

But *crystal growth doesn’t work like that*.

Even our ability to grow monolayers of one type of atoms on a crystalline substrate of another type relies completely on the propensity of these structure to form *spontaneously*.

Picture a liquid “soup” of various compounds — either a solution in a solvent or just a “melt” of one or more molecules that would be solid at lower temperature. If the concentration of certain components is high enough, then as we cool that “soup” we find that some of the components “like” to get together and form a particular crystal structure that represents the state of lowest *enthalpy* (a combination of entropy and binding energy) at that temperature. And, generally speaking, Nature does exactly what She “likes”. (Well, perhaps sometimes She does what She *has to*, but don’t let me catch you attributing that to the “Laws of Physics”!)

Once we have observed this phenomenon, we can usually *explain* it satisfactorily in terms of the essentially simple electromagnetic interactions between the atoms.

But can we *predict* the properties of the crystals that form from the laws of electrody-

namics? Only, I think, with the advantage of hindsight. I'm sure that crystal growers (some of whom I know) are able to predict the effects of adding or subtracting temperature, pressure, solvents or impurities to the "melt" or "soup" once they are familiar with the basic phenomenon; but it is extremely rare for a genuinely new crystallization phenomenon to be *observed*, much less predicted in advance.

So I will "state without proof" that **crystallization** is a good example of "Strong Emergence" in nature.

So now to the **metaphors**:

It's tempting to imagine that social change requires convincing an entire population (or a majority thereof) to cooperate in the pursuit of a new ideology, methodology or goal.

*Social change doesn't work like that.*

Instead, a *meme* surreptitiously grows (usually unnoticed) until it reaches a critical concentration in the chaotic social "soup" and orderly, organized "social crystals" begin to appear spontaneously in many places at once. We tend to find their similarity surprising, and suspect "conspiracies" of intelligent organizers — the social equivalent of Maxwell's Demon and his nano-tweezers.

Is anyone capable of *explaining* these social crystallizations after the fact? Sure! That's what Historians and Sociologists do for a living.

Is anyone capable of *predicting* them in advance? I think not. Lots of people (*e.g.* futurologists and science fiction writers) speculate freely (that's *their* job) and some of their *guesses* resemble the emergent social phenomena; but even a stopped clock is right twice a day.

How about Art? Artists mix ingredients into the hot "idea soup" in their minds and then cool it down until the crucial components begin to self-assemble into something that even they never really expected. Or so I suspect. It's certainly how creativity works for me. The best poem I ever wrote just came gushing out all at once without a shred of conscious planning on my part. It "crystallized" spontaneously on the page.

Even the papers I've written in refereed scientific journals have this attribute: I stuff ideas into my brain until it gets full, then I digest them for a while and add more as room comes available. Finally I realize what I really want to say and the paper "writes itself". (No wise cracks about the obvious alternate metaphor! ;-)