# Systems Architecture and Biomimicry

NOBLE CUMMING :: SYSTEMS THINKING
WEEK 9 :: NOVEMBER 18, 2012

## Situation

Even with The advent of modern vegetable inks, chlorine-free paper bleaching and 100% PCW & tree-free papers, paper still can have a hefty eco-footprint. This thing is, the primary function of paper is to share information and despite the best intentions of the digital realm, it is still the most efficient and economical material available for this.

Along these lines, it is very important that paper be recycled. But paper requires printing to serve it's primary function and the inks, foils and varnishes used in printing are the largest functional impediment to recycling. Another layer to this is that conventional and even vegetable-based inks release VOCs and leech hazardous compounds. Even the inks from hundreds of years ago were toxic to the workers that used them.

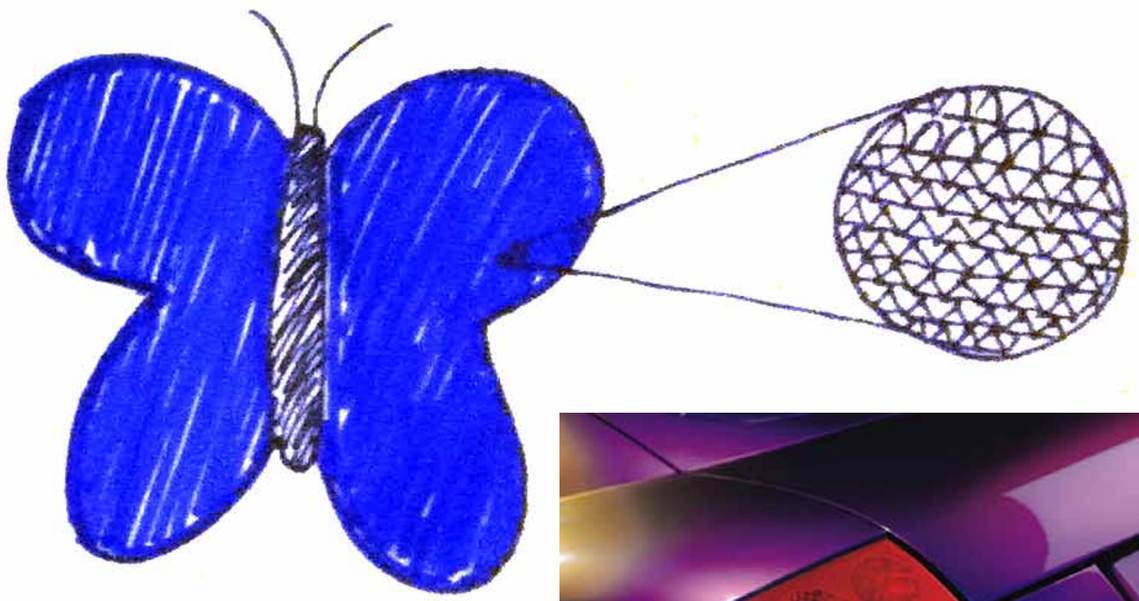
The system boundary revolves around a printed sheet of paper. The behavior would be how it creates the color and how long the color lasts on the page. Also, how it breaks down. The function would be the ability for the ink to communicate the message. In the case of the process, it would center on how the paper, the ink, and the foil is brought together before the use phase.

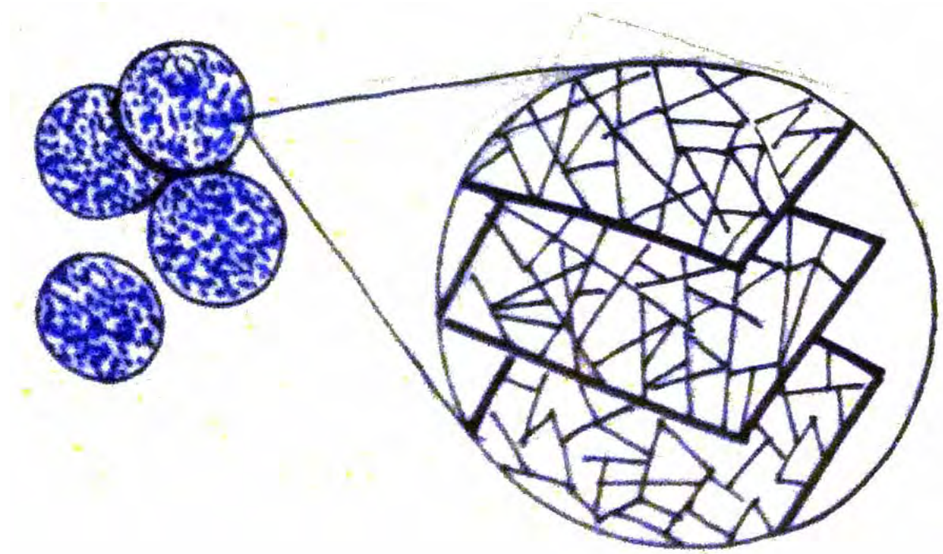
## Ideas

Inks with tints based on structural color could be used without the need for chemical dye. The colors would also be truer and longer lasting, and possibly not require any aqueous coating or varnish. So, I looked at this three ways to address this.

The first was changing current ink formulas. This could be done by adding structural elements to the ink vehicle as opposed to standard dyes. There is a company called JDSU that created a paint called ChromaFlair that would work in this way. The properties of ChromaFlair are based on butterfly wings.

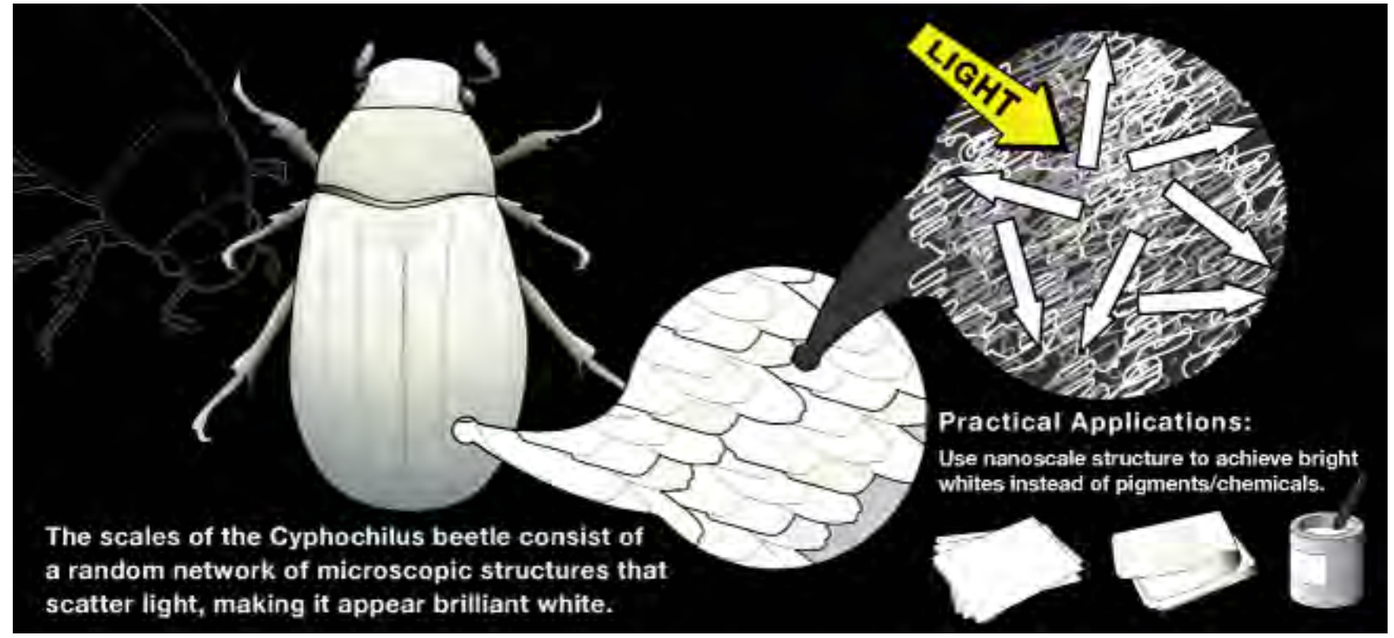
The second idea about addressing foils and varnishes. I was specifically intrigued by a fruit that science has known about for decades, the marble berry, which has recently been found to have it's structural color built in a layered manner (as opposed to the more commonly found series of scales over a surface). Currently, nobody has exploited the technology, but it shows promise for creating films of color much more readily.

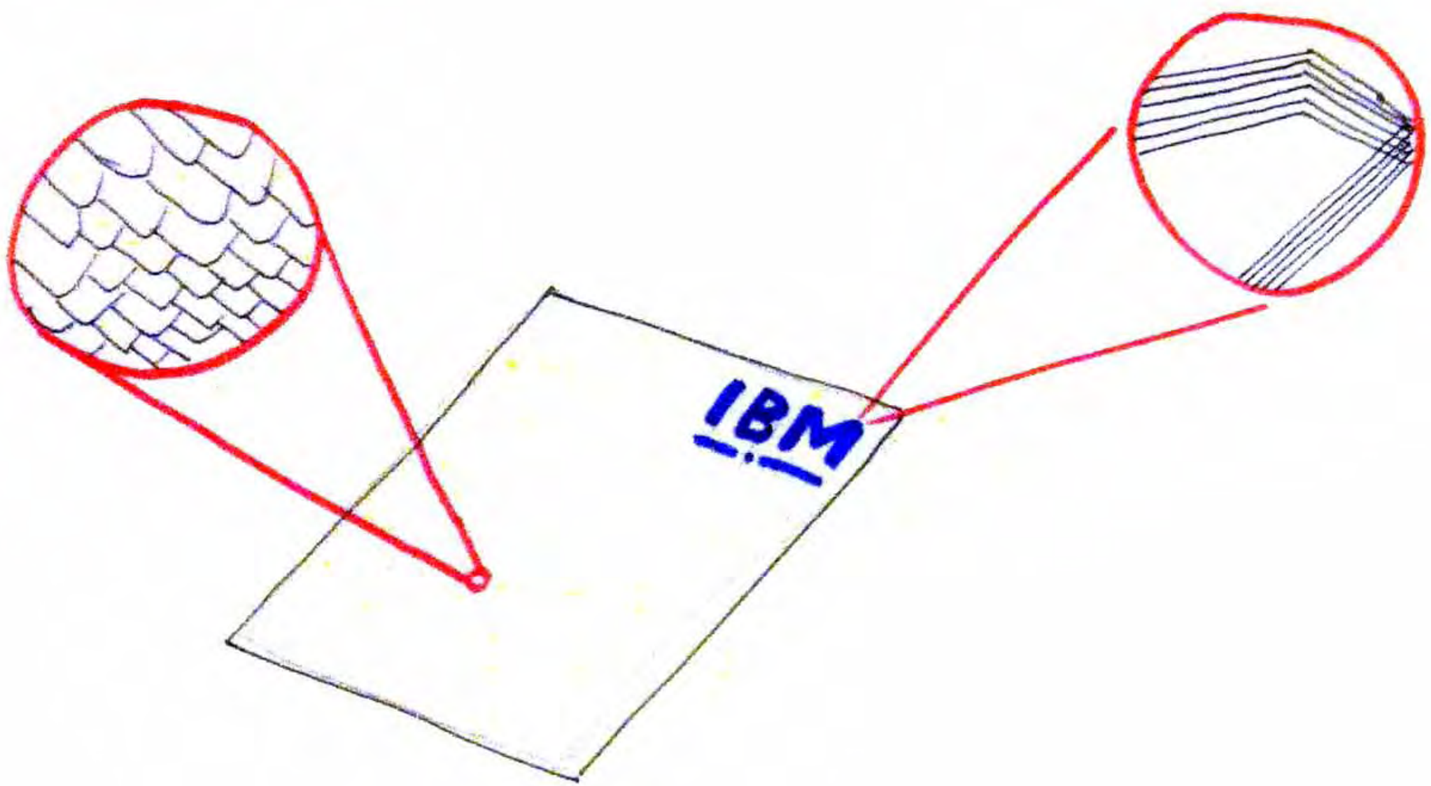


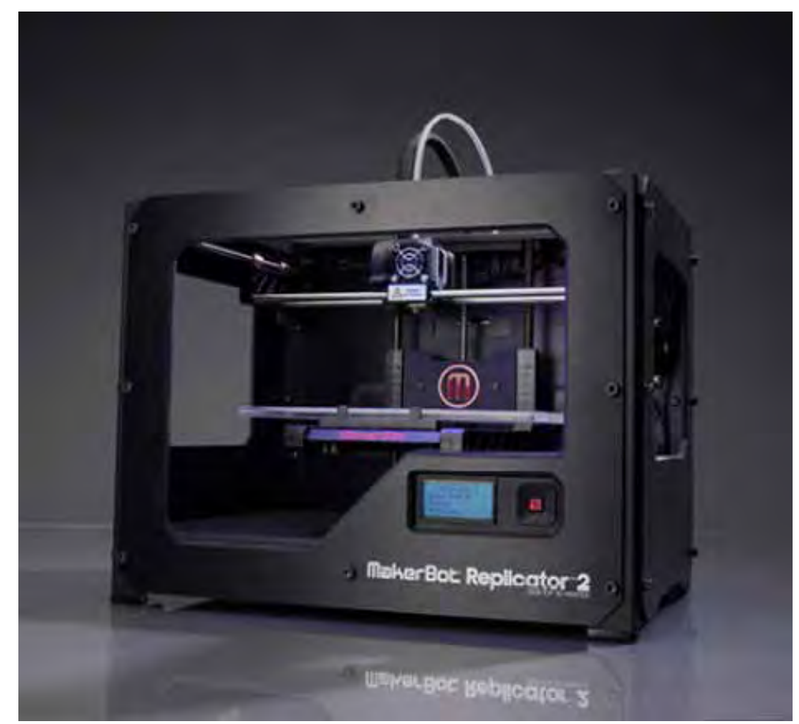


## Ideas, continued...

The third idea is around using the technology to build paper with the graphics as part of the paper. The paper industry has shown interest in using technology taken from the cyphochilus beetle to make paper white without the use of bleaching agents. If the graphics can be constructed using a cellulose-based material, then there would be no reason to have to de-ink paper, or concern ourselves with the loss of precious resources to a landfill when designers decide to use foils.



## Implementation

The third idea seems like the one worth grabbing on to. While the most outlandish of the three, it builds off of current technology and hypothetically follows printing industry trends. The use of 3D printer that could work on the nano-level, an advanced version of the MakerBot Replicator. Currently the Replicator 2 can get as detailed as 100 microns.

Another option would be a flatbed UV printer technology. Many versions of this style of printing use a layering effect instead of saturating the material. These have also shown their capabilities to be scalable, able to handle 1 or 100 with equal accuracy.

Since production scale versus speed is the main factor, it is advisable that this technology be performed in a printing facility or office environment. Current midsize offset printer technology starts at about 300 thousand dollars. If the layers are made using a cellulose-based approach, then the production stage would be virtually VOC free, the use stage would be lengthened with a lack of fading and smudge/smear resistance never before seen. The end-of-life stage would be left wide open for recycling.