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Black Chaos, White Trash: Order and Disorder at the Intersections of Mathematics and Culture

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Black Chaos, White Trash: Order and Disorder at the Intersections of Mathematics and Culture

By Ron Eglash, RPI

Abstract

Mathematical practices and knowledge are often in dispute for those race and class identities at the margins of social power. This talk will describe both the ways in which mathematics can be complicit with social domination, and the ways in which it can aid in resistance and reconfiguration. It will end with a presentation of Culturally Situated Design Tools, software based on the ethnomathematics of cultural artifacts from Native American, African American, Latino, and Youth Subculture communities.

I want to begin with the contrast between two concepts of social disorder, one based on race and the other on economic class. Let's start with race. The most common racial hierarchy placed all organisms on a single ladder, the "great chain of being," with Africans below Native Americans, Native Americans below Asians, and Asians below Europeans (Figure 1). This was first seen as an order ordained by God (who would be at the top of the chain closest to Europeans), and later as an evolutionary sequence. Although this biological determinism has faded in its popularity—a fading that always seems on the verge of resurgence, despite the total lack of evidence to support it—it was replaced by a model of cultural determinism.

Here the great chain of being stretches from Natural to Artificial, and the tone is often one of nostalgia for a romantic, organic past. When white South Africans created the Apartheid system, forcing their black compatriots into mythic "homelands" and stripping them of their human rights, they did so under the guise of extolling the

wonderful virtues of the "natural" African, who was not tainted by the unfortunate contact with the polluting artifice of urban life. Anyone who has seen the film "The Gods Must be Crazy" knows this routine—innocent "good" Africans who kept their place in nature, the bad revolutionary Africans who must be sadly locked away as their fragile culture had been polluted by the craziness of urban artifice. The same romantic organicism was used to create the myth of the Vanishing Native in the U.S. The "real" Native Americans were said to have vanished, and those remaining would have to be locked away since they had lost their "natural" place in the harmonious chaos of the ecosystem.

Thus primitivist racism depends on seeing some people as closer to nature than others; the chaos of nature must be kept in its proper place. But this stands in stark contrast to the classist designations applied to white people. This is well illustrated in Frykman and Lofgren's Culture Builders, which details the construction of the middle class in 19th century Sweden. The middle class constructed itself as romantically attuned to the chaos of raw nature, and often portrayed raging streams and jagged mountain peaks in its postcards and paintings (Figure 2). The middle class developed hiking clubs, nature preservation societies, and my own favorite, the Friends of Small Birds Society. One can just imagine a factory owner ignoring the plight of low-wage workers in his sweatshop, while wringing his hands with concern over the winter survival of chickadees.

The working class, as constructed by the Swedish middle class, was unable to appreciate the sensitive chaos of nature. One sees similar views in the US today in the middle class disgust over working-class behavior in beaches and parks: their music is too loud and too metallic, their obsession with automobiles is unnerving and unnatural. Such

stereotypes have their ultimate expression in the designation of “white trash,” a term that eventually merged contempt for the working class with the eugenicists’ fear of genetic pollution. If the primitivist view of black chaos can be seen in “The Gods Must be Crazy,” then the complementary film for a classist view of white trash would likely be “Deliverance.” Here Burt Reynolds and his middle-class crew strive to find the redeeming chaos of nature (canoeing down an “untamed” river), only to be thwarted by local rednecks who neither fit nature nor bourgeois culture.

In summary, we have the following categories for racism and classism (Figure 3): Primitives are seen as having their proper place close to nature; they are only a problem when they lose that natural chaos and are polluted by white culture’s order. White Trash, on the other hand, have no proper place. They are outside both nature’s chaotic harmony and white culture’s bourgeois order, without chance of redemption.

Mathematics has been used to both construct and resist this oppressive schema. You are probably familiar, for example, with the story of Frances Galton, who made his mathematical reputation in statistics. Galton assumed that the differences between what he termed savage and civilized people were due to genetic predispositions, and he saw class differences in the British population in the same way. Galton’s breakthrough concept was “regression towards the mean”—the tendency, for example, of two tall parents to have children that were closer to the mean height of the population. He used this statistical property to portray the upper class as under constant threat of losing its superior gene pool. It was Galton who coined the term “eugenics” to promote the breeding of these superior humans. Several of his intellectual descendents in the US, in particular H.H. Goddard around 1910-20, use statistical claims to promote the isolation

and sterilization of “genetically defective” poor whites, again marshalling the tools of mathematics as a means of ensuring class hegemony (Figure 4).

My own interest is focused on mathematics as a mode of resistance. In the late 1980s I found that aerial photos of African settlements show a fractal structure: circular houses in circles of circles, rectangular houses in ever-diminishing rectangles, etc. (Figure 5). After a year of fieldwork in west and central Africa, I found that these patterns were not, as I had originally assumed, the result of unconscious social dynamics, but rather intentional design, with social meanings mapped onto the scaling architectural patterns. Moreover such scaling patterns were found in a wide variety of designs: textiles, paintings, sculptures, hairstyles, religious symbols, and many others. The artisans who created these structures often had specific geometric algorithms for generating these scaling patterns, and in some cases even numeric algorithms.

Back in the US I published a book, African Fractals, which showed both the original designs along with their computer simulations, and attempted to engage math teachers in using this text. I ran into two problems. First, Benoit Mandelbrot’s famous manifesto was titled “The Fractal Geometry of Nature.” Thus I have been plagued by readers asking me if the existence of African fractals shows that Africans are closer to nature. I then launch into the diatribe to which you have just been subjected. The second problem was a bit more serious. African American math teachers would tell me that not only are their black students having difficulty with math, but they also don’t know much about Africa. But they all said that the hairstyle examples would work well, because cornrows were something that was part of their own lives.

My first online program for engaging students in these simulations was thus based

on cornrow patterns (Figure 6). We now have an extensive website developed around this applet, which covers the cultural history of cornrows as well as providing a tutorial. Meanwhile I was contacted by an educational group at the Shoshone-Bannock reservation in Idaho, including Jim Barta at Utah State University. They had seen the African Fractals book, and wanted to know if I could do something similar with Native American culture. That resulted in our most successful software to date, the Virtual Bead Loom (VBL).

The VBL screen begins by showing the prevalence of four-fold symmetry in Native American design, where the "four directions" concept, an indigenous analogue to the Cartesian coordinate system, structures astronomical observations, calendars, numeric systems, and other knowledge domains. We then move to the Shoshone beadloom, showing the underlying Cartesian structure of its grid, and finally to the virtual loom (Figure 7). Here students can enter numeric coordinates for bead position; along with color choice, this enables pattern capabilities similar to the indigenous loom.

The initial version only had a single point tool, so I asked my programmer to create a tool that would allow students to draw lines, rectangles, and triangles of beads. When we compared the resulting triangles on the virtual beadloom to the triangles in Shoshone beadwork, we got quite a surprise: the jagged, irregular edges in the virtual beadloom never appeared in the Shoshone version. After returning to the reservation to interview the beadwork artisans, we learned that they were using iteration. We have incorporated that approach in a new VBL tool, but left the old tool there as well so that students could see the contrast. The VBL has been our most successful simulation; it is now in use at three schools serving Native American reservations, as well as several others. Middle school teacher Adriana Magallanes ran a quasi-experimental study of the Virtual Beadloom for her master's thesis. She compared the performance of Latino students in two of her pre-algebra classes, one using the beadloom, and the other using conventional teaching materials. She found a statistically significant improvement in the math test scores of students using the beadloom.

Another simulation that began at the Shoshone is based on three-dimensional structures, such as baskets, tipis, etc. This came from a request by the science teacher, Ed Galindo, to generate a simulation of the pre-European contact social ecology. I engaged several RPI students in the task of creating a storyboard, and we presented it to the students and teachers at the Sho-Ban school. The simulation storyboard, in contrast to the VBL, was a near disaster. The RPI students had based their simulation concepts on familiar games, in particular "Dark Ages," in which players became medieval characters attempting to develop and defend their local village. The Shoshone-Bannock school students and teachers pointed out that a simulation in which everyone stayed rooted to one spot was replicating the reservation system—certainly not a representation of traditional life—and that the graphic characters might be too close to the offensive cartoon Indians portrayed in sports mascots. They suggested that a more accurate simulation would show how populations shifted to different areas with the seasons, and that a simulation player should learn about the technologies and activities associated with each. Many creative suggestions were then opened up for new kinds of graphical interface, some of which our programming team is still striving to understand. In addition to gaining new insight into how to provide more appropriate software for the Shoshone-Bannock students, this experience has also helped us illuminate the ways in which software subculture affects the supposedly "cultureless" world of computer programming (e.g., influence such as the "Dark Ages" game is a part of hacker subculture). Rather than see the computer programmers as the ones with all the technology, and the Shoshone as the ones weighed down with cultural baggage, we are seeking a portrait of Shoshone technology, and a cultural account of computer programmers.

We decided to focus on four food-gathering technologies, each associated with one season. Students are able to explore the underlying geometry of these four structures by manipulating numeric parameters. Our first field test of SimShoBan took place in June 2001 at Ed Galindo's summer science camp. Located at 9,000 feet in Idaho's Saw Tooth range, the camp makes use of the tribal efforts to restore salmon as a teaching opportunity for students from the Shoshone-Bannock reservation. We set up laptops in the back of an SUV and guided students through the use of both the virtual beadloom and an early prototype of the food-gathering technology simulations. Here we see some of the students' creative manipulations of these virtual structures. Although we introduced the simulations as a "game" whose goal is to "get as close as possible to the original," students quickly learned how to abuse the system, creatively modifying the simulations into forms unrecognizable as traditional artifacts (Figure 8).

It might be confusing to see so much effort go into a simulation capable of generating native artifacts, only to find that we celebrate the students' devious avoidance of such modeling fidelity. But as I tried to make clear in the introduction, forcing native students to keep their proper place in harmonious nostalgia for the past is not a goal here. The basis for this work is ethnomathematics, a direct assault on primitivist stereotypes of indigenous cultures by translating their mathematically sophisticated practices into forms that are recognizable to the formal school context. But where minority students choose to take those design tools is a matter of their own choosing. These culturally situated design tools are not only pedagogical devices, they are also expressive media.

So we now have a wide variety of these design tools, including rhythm patterns in music, Eskimo parkas, graffiti, and much more. But I am still struck by the ways in which

the redemptive move against primitivism—the simple gesture of translating indigenous knowledge into formal school representations—seems inadequate in the case of working-class whites. It's true that we can perform the same ethnomath investigations of blue collar culture, but there is something lacking in that approach. At the same time, we have to wonder, why the difference—why, for example, can we name a dozen books on black scientists and inventors, and not one on working-class scientists and inventors?

Let me close, then, with a couple of quotations from working-class mathematician George Boole. Boole was born in Lincoln, England in 1815. In our time George Boole is most famous as the inventor of Boolean Algebra, the binary logic that runs our digital circuits. George Boole's exposition on the relations between linguistic expressions and mathematical logic includes several racial examples, such as the following (Boole 1854 p. 37—see also p. 49):

> Still representing by x the class "men," and y "Asiatics," let z represent the adjective "white." Now apply the adjective to the collection of men expressed by the phrase "Men except Asiatics," is the same as to say "White men, except white Asiatics." Hence we have: $z(x-y)=zx-zy$.

Given the attitudes of his day, one might expect to find that Boole used such mathematizing categories to promote the racist hierarchies of Galton and others. But Boole was distinctly anti-hierarchical. His mother had been a maid, and his father was a struggling shoemaker. Boole's life was distinctly marked by class status. He stated that

his interest in mathematics started because he had very little money to spend on texts, and decided that since mathematics books took the longest amount of time to read, they offered the best value. His working-class background resulted in a mathematics pedagogy that emphasized practical application and hands-on experiential learning, in contrast to the emphasis on abstraction popular at that time. He had several important papers published in the Cambridge Mathematical Journal, but was unable to attend Cambridge himself due to financial barriers. He finally found a faculty position at Queens College in Cork, Ireland, where he spoke of the kind tolerance of Catholics towards him. His own religious beliefs turned towards Unitarianism. On May 29, 1855, he delivered an address to the Cuvierian Society for the Cultivation of the Sciences (McHale 1985 pp. 123-124):

> You will be conscious of the existence of bonds by which each age and each country stand connected to all others. You will feel there is such a thing as humanity. …When therefore I use this term, I would be understood to mean by it the human race, viewed in that mutual connection and dependence which has been established…. Each new revelation… is a step… in the history of our species. Could we trace back our pedigree… [w]e should see picture writing, most probably, of some forgotten Asiatic tribe… analogous to those which are still preserved in the monuments of Egypt…. To the Arabians we owe our numerals, and through this the science of arithmetic.

In contrast to the racist hierarchies of his day, Boole saw his logical categorization as a means to express the unity of the one human race. Lets hope that our own investigations into the intersections between culture and mathematics will be equally successful.