BOOK REVIEW[1]

African Fractals – Ron Eglash

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This book offers a rare case study of the interrelation between science and social realities. Its aim is to demonstrate the existence of advanced mathematical concepts, such as fractals, in African indigenous cultures. The idea for the research comes from the realization that the structure of certain indigenous villages represents fractals, a complex mathematical form that can be also found in traditional art pieces. The research question is if these cultural features rely on an actual knowledge of the mathematical concept of a fractal – something quite advanced from the point of view of Western mathematics – or were due to any other reason, such as the imitation of natural features. In that sense, the author is looking for evidence of conscious knowledge associated with the production of these fractal features, and an abstract understanding of the logic implied in them. Therefore, the underlying purpose of the book is the attribution of *value* to the African indigenous cultures through the recognition of their knowledge.

This process of validation is not absent of theoretical problems: the first is what criteria should we use to validate a human culture, the second problem is how do we define the subjects of the validation process, and a third one could be from which position are we going to validate other cultures.

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[1] The book review was part of the work for the PhD course *Theoretical traditions in Information Studies: Science and Technology Studies*, by Professor J.F. Blanchette. IS Department at UCLA.

The nature of the attribution of value proposed in the book follows the criteria of level or complexity of knowledge as a measure of human or cultural value. Therefore, the argument and intention of the book has a necessary counterpart: what would happen if these or other human cultures fail to represent any scientific or theoretical advanced concept? Can we diminish the value of cultures without intellectual sophistication? Is it correct or fair or acceptable to validate human cultures and human beings based on the complexity of their knowledge? These questions point at the underlying belief of STS (at least according to the literature reviewed until now) that is also at the core of our culture: the production of knowledge is what justifies human value. From an academic or intellectual point of view, it is a difficult to be critical of this belief, because the abstract appreciation of knowledge is also the motivation for intellectual work. However, this questioning process is worthy of consideration even if we have to go in the depth of the human essence, because that is the only way to build a coherent frame for the discussion of issues of multiculturalism. In any case, these questions go beyond the possibilities of this commentary[2], although they are pertinent here because of the author's intention of validating other cultures based on recognition of complex systems of knowledge.

The definition of the subjects for the validation process[3] is also highly problematic. They are presented as "African indigenous cultures." Obviously, the intention is to validate a cultural set that represents the opposite from Western and modern culture, and what better than Indigenous cultures. Plus, Africa seems to be, through all the examples given in the book, a good place to find indigenous communities that manage to live their own way even nowadays[4]. Also, later on the book we can find a reference to the lack of representation of African traditions in multicultural mathematics (mainly presented as Asian and Arab mathematics). So the book also attempts to fill that gap.

However, the author presents his choice as a direct result of the actual distribution of fractal cultures that are mainly African, regardless of some minor examples in other continents. This is also akin to a

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[2] It could make a pretty good dissertation, though.

[3] The research question ask directly about whether or not mathematical theoretical knowledge can be found in these cultures, and it is based on the implication that knowledge has an humanistic value. Therefore, the research is in itself a validation process that could be positive or negative, even though only the positive one would result in a publication.

[4] There is no mention of problems with governments, corporations or other big players of the modern world, aside from the tourists that eventually buy fractal art pieces. It is not that these conflicts do not exist in Africa, it is just that the author oversights them or focuses just on communities without serious problems.

particular style very common in STS, where knowledge and its artifacts are used as an objective justification for the study of other type of phenomena. Everything seems to be about fractals (or albums, or statistics, or means of transportation,) but in the end everybody is talking about something else, about realities of a social and anthropological nature: the validation of non-hegemonic cultures, the epistemological construction of evidence, the growth of the scientific production, private transportation as a mean of *distinction*, and so on[5].

In the present case, the inclusion of the fractals from non-African cultures that are also identified in the book (Celtics and another small community in North-America) would have given more credibility to the pure interest in fractals, because rare cases are always relevant in the study of general patterns[6]. Not including them reinforced the idea that the point is not about how indigenous population understand – or understood - fractals, but about the complexity and sophistication of "African knowledge".

This generalization of "African knowledge" and the use of Africa as a unified cultural category[7] addresses indirectly the question of race and racism: the political implications of the research are an evidence against racial prejudices towards the black population. This effect is also reinforced by the connection of the African knowledge of fractals with the education of African Americans: "It is really very successful teaching children that they have a heritage that is about mathematics, which is not just about singing and dancing" (TED Talk, min 14). In the book, this issue is explained very carefully (p. 222) in order to avoid any possible misunderstanding. The main idea is that among the social inequalities that affect African American children - briefly mentioned with reference to other scholars, but not directly treated in the text – is the lack of an appropriate ethnic representation in the sciences:

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[5] This paragraph refers to other books of the syllabus of the Science and Technology Studies course. In order: African Fractals, Objectivity (Daston and Galison), Little Science Big Science (Solla Price) and Aramis (Latour).

[6] From an Anthropological point of view, the introduction of rare cases offers a better perspective to understand the underlying dynamics of the cultural feature being studied.

[7] Even if the author admits that it is not a single cultural category and that there are many cultures in Africa, it seems to be possible to culturally unify all of them through the fractals. By the way, Arab indigenous communities in North-Africa are not even mentioned in the book. However, the oversight of certain realities in geographic references is very common: "America" usually stands for North-America, if not for United Estates; "Europe" is usually understood as Western Europe; and "Asia" as Eastern Asia.

"Powel (1990) notes that pervasive mainstream stereotypes of scientists and mathematicians conflict with African American cultural orientation" (p. 223.) Therefore, "By showing the presence of complex mathematical concepts in African culture, we can mend some of that damage" (p. 225)

Indigenous culture and the nature of knowledge

The other characteristic of the subject of validation is being indigenous and/or ancient, which means they represent the directly opposite pole of Western modernity. The idea of these non-modern and non-Western cultures having advanced mathematical knowledge, consciously transmitting it to new generations and successfully applying it in practical ways – such as the construction of wind fences or the smart design of clothes – challenges the hegemonic authority of Western knowledge. To such an end, the use of mathematics seems to be highly appropriate, because its abstraction makes it easier to overcome cultural boundaries.

Eglash's exposition reach a climax in the explanation of the engineering applications of indigenous knowledge of fractals. The example of the wind fences (p. 71-73) connects with the most classical Western understanding of what knowledge is for: optimization of work and maximization of benefits. However, the philosophical and spiritual implications of fractals in these cultures receive a broader treatment in the book, probably because indigenous cultures give more value to the representation of the meanings of life than to the practical-utilitarian application of knowledge.

A good example of these philosophical meanings of fractals is the presentation of recursivity as a social and spiritual value associated with the reproduction of life, often represented as a snake eating itself. This emphasis in recursion collides with Western platonic metaphysics as well as with the idea of a linear progress of society. Another example is the infinity and the impossibility of measuring fractals in absolute numbers, a quality that challenges the Western obsession with measurement and manipulation, making the indigenous acceptance of life's complexity a matter of admiration for the openly minded reader.

All these philosophical concepts and reflections connect with the posmodern rebellion against Western metaphysics and the project to develop an alternative theoretical framework, able to capture the

complexity of culture and the "relative relativeness[8]" of knowledge. This connection is briefly explained at the end of the book, when the author digs deeper in the implications of his research, implications that at certain points seem to have more to do with an epistemological justification of the research than with its empirical conclusions.

In this final part of the book, Eglash presents a beautiful and synthetic interpretation of the nature of mathematical knowledge, which is at the same time discovering and construction. In comparison with European mathematics, it becomes clear that mathematics – as an abstract representation of knowledge in general – begins always from a socially and culturally constructed framework that is necessary to explore the structural or universal laws of reality. In the author´s words: "we are free to construct culture within the constraints of the universe in which we live." Mathematics (science) interrogates the universal constraints (discovers them,) but only from the constraints that our cultural frameworks provide us (which are human constructions). For example, the decimal system is a human construction, but the calculations made with it are the result of universal laws.

Side by side with these epistemological considerations are the social implications of different forms of knowledge. The bottom-up system of organizations provided by the indigenous non-state societies, supported by the auto-reproductive characteristics of fractals, becomes a highly suggestive proposition, aimed to consider indigenous knowledge as a possible inspiration for new forms of social organization. The author also proposes different forms of integrating indigenous and fractal knowledge in a wide range of areas, from sustainable development to architecture or to decision making processes. These considerations are also made with Eglash's careful (even calculated) style, avoiding simplistic interpretations. For example, he explains clearly that either Euclidian or fractal geometry can be associated with oppressive or liberating social practices, and that the understanding of fractal and indigenous cultures are not a final answer, but offer us new concepts to think about actual social problems.

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[8] Knowledge only has meaning in an specific cultural frame, but once the frame is defined the relation between elements are necessary, which is the same point that Eglash makes about the nature of mathematics.

Ancient Egypt

The inclusion of ancient Egypt as another African Culture that uses fractals deserves a special mention, as it is not a non-state indigenous culture. The rhetorical effect of the aggregation of a pristine state – and one of the most developed civilizations of all times - to the pool of African cultures is the automatic upgrade of the cultural validation of the whole group, at least to the eyes of Western hegemonic culture. Eglash explains that the knowledge of fractals could have passed from indigenous non-state societies to ancient civilizations (state cultures) and then – or at the same time – to Western civilizations, where these pieces of knowledge remained silent until recently.

According to Wikipedia, authors like W. E. B. Du Bois "have supported the theory that the Ancient Egyptian society was indigenous to Africa and mostly Black[9]," an interpretation that was also used as a powerful counterargument against racist discourses, in a similar fashion as the one used by Eglash. In both cases, the evidence of knowledge that could be validated from a Western perspective – whether it be fabulous pyramids or complex mathematical principles – is presented as a validation argument against racism. However, these arguments imply the problems that we have seen at the beginning: what is the criteria to validate a human culture? How can we generalize without reinforcing the notion of race?

"Since the second half of the 20th century, scholars have rejected the notion of race as having any validity in the study of human biology" (Wikipedia, same article). Therefore the question of the most common skin color in ancient Egypt lacks relevance, because it would be a minor physical detail, that was not even relevant at that time[10]. However, this intellectual asepsis turns out to be weak when it is about counterarguing racial prejudices, because instead of "picking up the gauntlet" to vanquish those discourses, it avoids the discussion marking it as pointless. Eglash is conscious of this paradox when he describes the tension between the perspective of sameness and difference of ethnic groups, both having their own problems and their own strengths.

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[9] http://en.wikipedia.org/wiki/Ancient_Egyptian_race_controversy Retrieved 02/12/2013

[10] It seems also that in ancient times there were no racial distinctions, that they are the result of modern theories. Wikipedia quote: "Frank M. Snowden asserts that *Egyptians*, *Greeks and Romans attached no special stigma to the color of the skin and developed no hierarchical notions of race whereby highest and lowest positions in the social pyramid were based on color.*" (cursive is a quote inside the quote)

Fractals and complexity

The fractal metaphor can be useful to deal with these kind of paradoxes, as it provides a way to harmonize infinite contradictions in a unified concept, superseding the limitations of linear thinking. This idea goes in accordance to concepts like *Unitas Multiplex* from the Complexity Theory (see Edgar Morin[11]) that proposes the integration of all human cultures in a common unified frame which, in its complexity, would allow the existence of internal differences.

This metaphor can be also applied to describe cultural and personal identities (pag. 200) that evolve from the hybridization of different traditions or backgrounds; hybridizations that are never a mix of different things but different things at the same time. Like in Cantor's infinite fractal (pag. 208), it is impossible to find a middle point between the two or more elements that conform our identities.

The final section of Eglash's book offers a wide range of possible applications of the concept of fractals to modern problems. The most appealing idea there is the possibility of integrating the knowledge of the indigenous communities in the projects of modern development, reconciling tradition and innovation in a complex unity, thanks to the theoretical framework provided by fractal theory.

Bibliography:

Eglash, R. African Fractals: modern computing and indigenous design. New Brunswick: Rutgers University Press 1999.

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[11] Morin, Edgar. *Introduction à la pensée complexe,* 1990. Ed. Points.