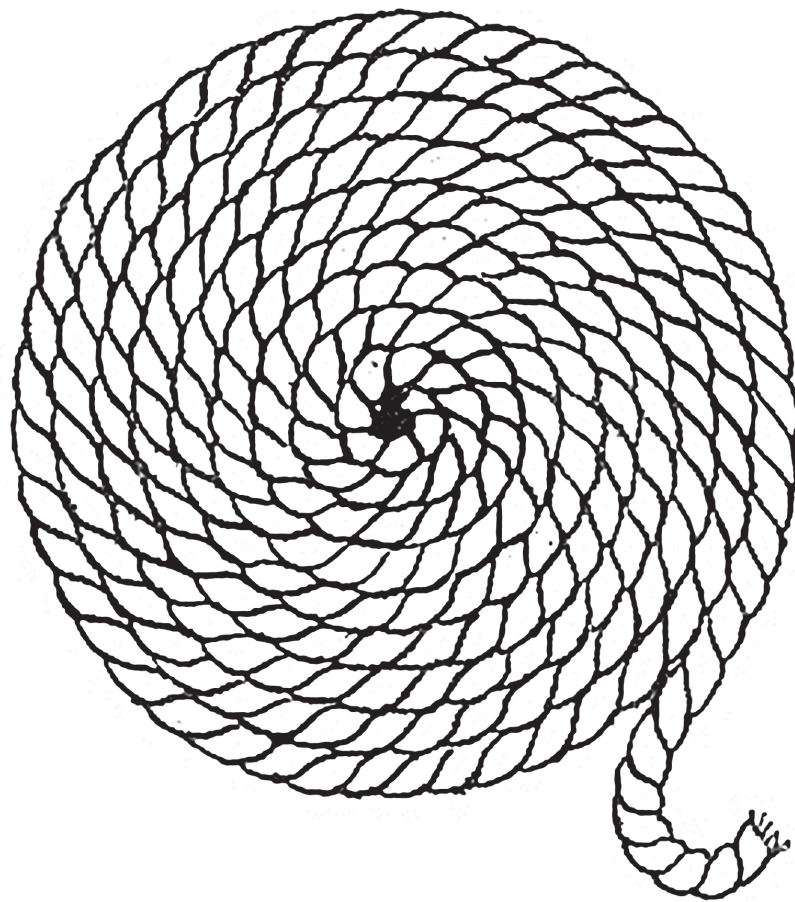




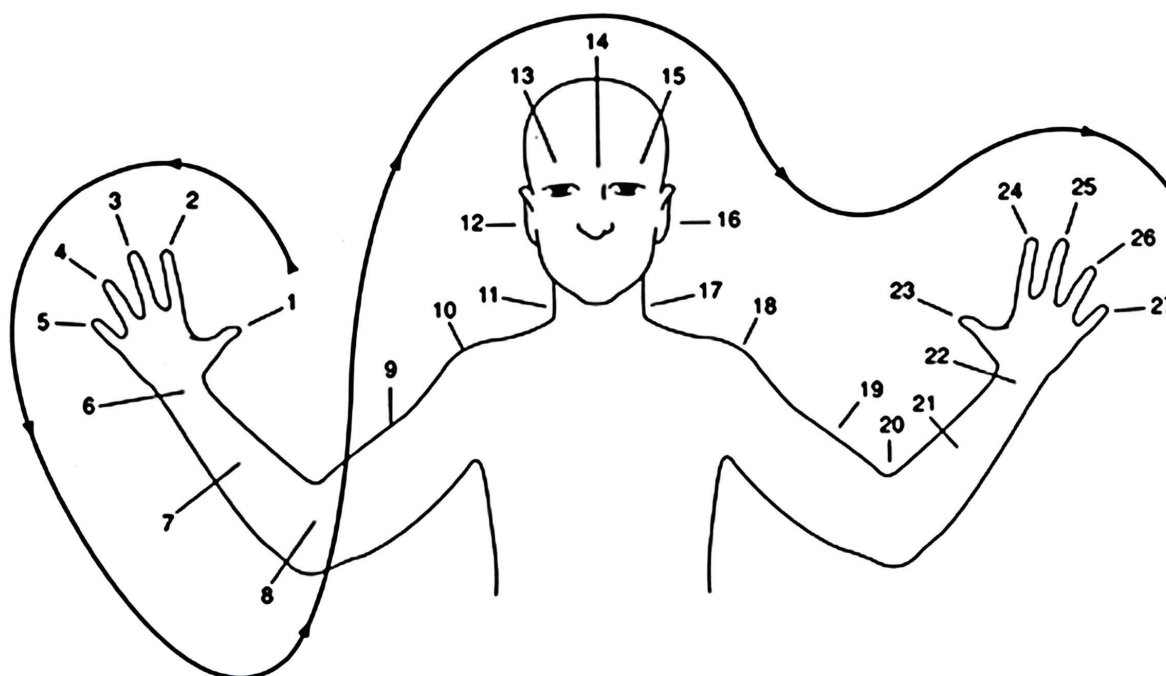
## 0

# Fragmentizing what seems universal and continuous

In the development of this new language for a new perfect communication, the scientist recovers the integrality of her path traveled at the moment of an important invention. Therefore the history of this language transforms as soon as its advances are investigated. It often happens that an expert judges that one of the systems preceding her own that she no longer uses is nonscientific or prescientific: it is not included in her history. Many times during the development of this language the question focuses on an element, and many times the response to the question reconstructs the foundations, not only of what is accepted as truth at the point of departure but also of the foundations that underlie the constitution of the element in question. Thus each new system in turn projects its own history, and some elements have many histories related to them. They appear in different domains, in different positions, on different foundations. Although invariants, it seems that these elements never refer to the same system of thought, such that it is a question neither of a stable figure nor, perhaps, of the same language. Are these elements then the same or always different?

based on: Michel Serres, *Differences: chaos in the history of the sciences*

- 1 Exchanging one for plural
- 5 The logic of the detail



# 1

## Exchanging one for plural

Knowledge is continually created and re-created as people reflect and act on the world. Knowledge therefore is not fixed permanently in the abstract properties of objects but is a process in which gaining existing knowledge and producing new knowledge are two moments in the same cycle. In addition, knowledge requires subjects; objects to be known are necessary, but they are not sufficient. Knowledge necessitates the curious presence of subjects confronted with the world. It requires their transforming action on reality. It demands a constant searching . . . . In the learning process, the only person who really learns is she who reinvents that learning. How do we learn to understand others? How do we recognize, understand, and describe the knowledge and voice of the other? How do we learn to understand something that we have not learned to understand before? How can we perceive the variety of mathematical practices for what they are and understand in what sense they are different without placing our perceptions in old (binary) structures that promote categorization, mapping, etc.? How do we orient ourselves while learning to deeply understand the plurality of things?

based on: Marilyn Frankenstein, Critical Mathematics Education: An Application of Paulo Freire's Epistemology

► 2 Negotiations in exchange

► 6 Changing perspectives



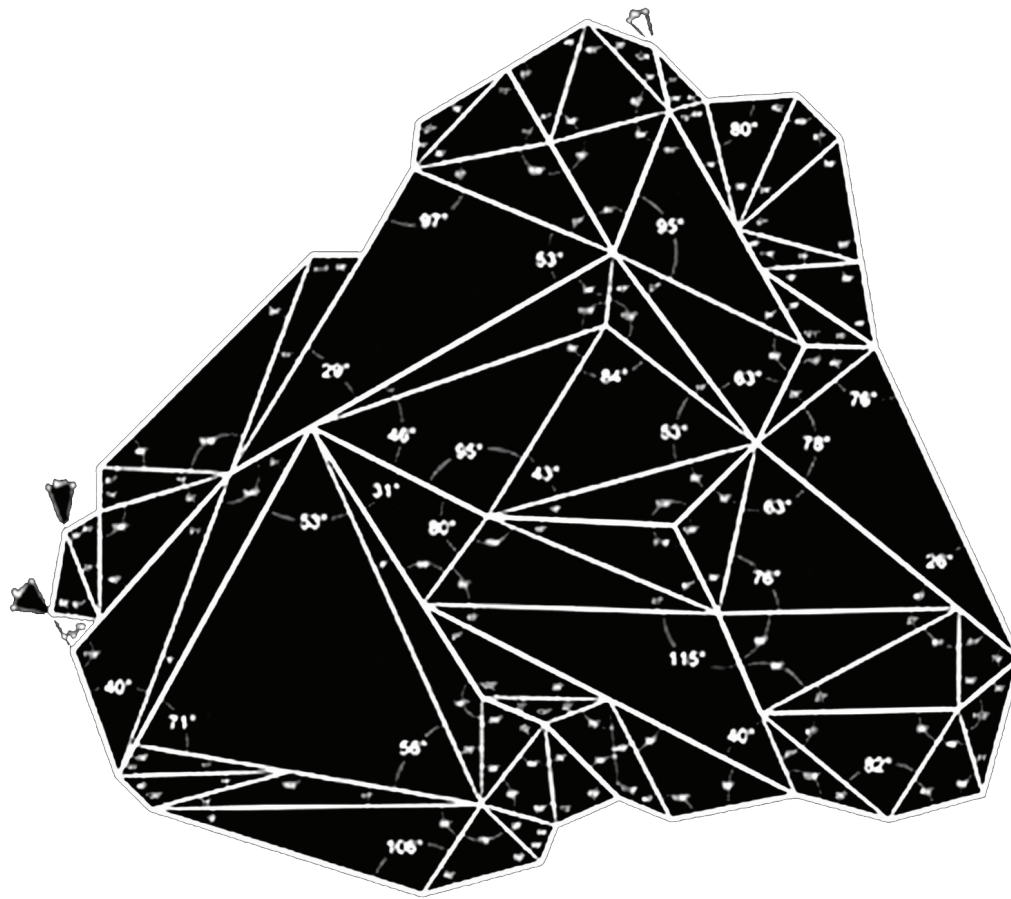
## 2 Negotiations in exchange

Making sense out of a numerical world means more than understanding the relations among its arithmetic elements; it means more than understanding standard systematizations of quantitative relations. In practice, the relations among arithmetic elements become intertwined with other kinds of concerns in the world. Behind the numbers are the interests of the other. Numerical culture has become so dominant that even for peoples who did not orient themselves extensively by means of numerical calculation until recently, numbers and money become in some senses the arbitrary means for quantitatively comparing unlike things on a scale that is supposed to be common to them all. However, this does not mean that logics are all the same. Different worldviews and the everyday experiences of individuals account for diverse strategies of mathematical reasoning, based in different values and symbolic properties. Consequently people will use mathematics in different ways to solve arithmetic dilemmas, conflicts, and tensions. How does this emerge in cross-cultural transactions, for instance, in a negotiation between a total system of reciprocal gift exchange and capitalist economics? How can knowledge of mathematics become a critical tool and a means of resistance against a dominating culture?

based on: Mariana Kawall Leal Ferreira, when  $1+1 \neq 2$ : making mathematics in central Brazil

►3 Reading the world with mathematics

►7 Examining the basis



### 3

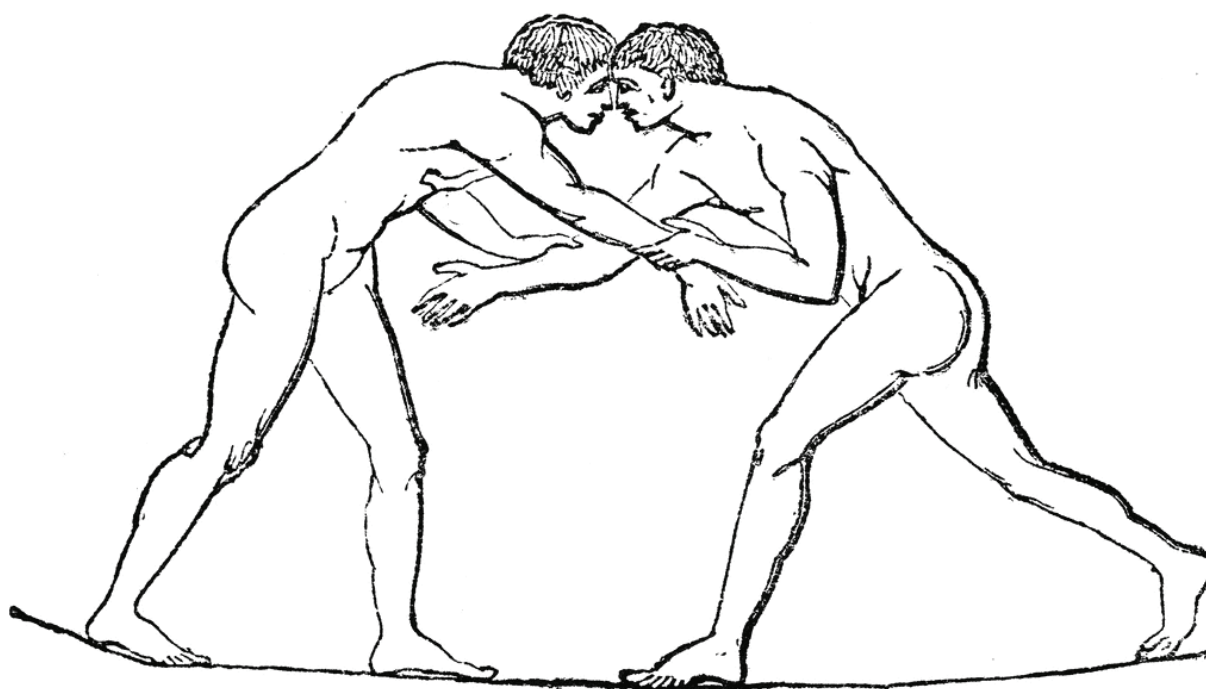
## Reading the world with mathematics

At first these mathematical concepts and models exist in theory. When they become the basis for formalizations of language and action, they are transformed into realized abstractions (e.g., time, space, and money) in the social realm, where they are then materialized as symbols, technological constructs, and organized systems. What was once explicit mathematics becomes a system of implicit mathematics shaping peoples' lives. When societies become more and more technological, people have to act in a system that embeds increasingly more, and more complex, mathematics without explicitly knowing or understanding the underlying mathematical abstraction processes. The result is a black box, which one has to trust in the form of a machine, a specialist, or an institution. In a technological society, what competences express empowerment? How can mathematics be used to understand relations of power, resource inequities, and disparate opportunities between different social groups as well as explicit discrimination. How can mathematics be used to dissect and deconstruct media and other forms of representation? In short, how can mathematics help to examine various phenomena in one's immediate life and in the broader social world and to identify relationships and make connections between them? How do we read the world with mathematics?

based on: Eric (Rico) Gutstein, *Our issues, our people: Mathematics as our weapon* and Renuka Vithal and Ole Skovsmose, *The End of Innocence: A Critique of Ethnomathematics*

► 4 Learning in proximity

► 8 Accepting two accounts to be equally valuable



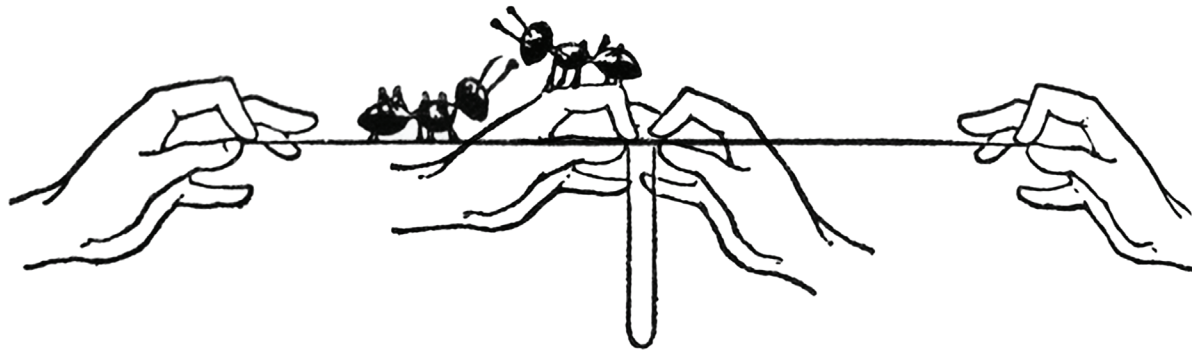
## 4

### Learning in proximity

A home, whatever shape it takes, is primary and fundamental in bringing order and harmony to one's life. The lack of harmony and beauty in the built environment affects people's thinking, perceiving, and relating to one another, as well as increasing the alienation many feel toward their surroundings. Aspects of people's lives such as the impact of the built environment and the use and abuse of the place in which they live are subtler and less visible than other dangers faced and thus may be more dangerous. How can mathematics help people understand their relationship with the space they inhabit and so help bring sense, harmony, and sanity into the lives of the people who live in it? What is the purpose of teaching geometry, in particular, if ordering the place in which people live is not one of its primary concerns? How can the teaching of mathematics become a counterforce against the arbitrariness in people's lives due to imposed and oppressive restrictions on movement and use of space?

based on: Munir Fasheh, Is Math in the Classroom Neutral – or Dead? A view from Palestine

- 0 Fragmentizing that what seems universal and continuous
- 9 Future mathematics?

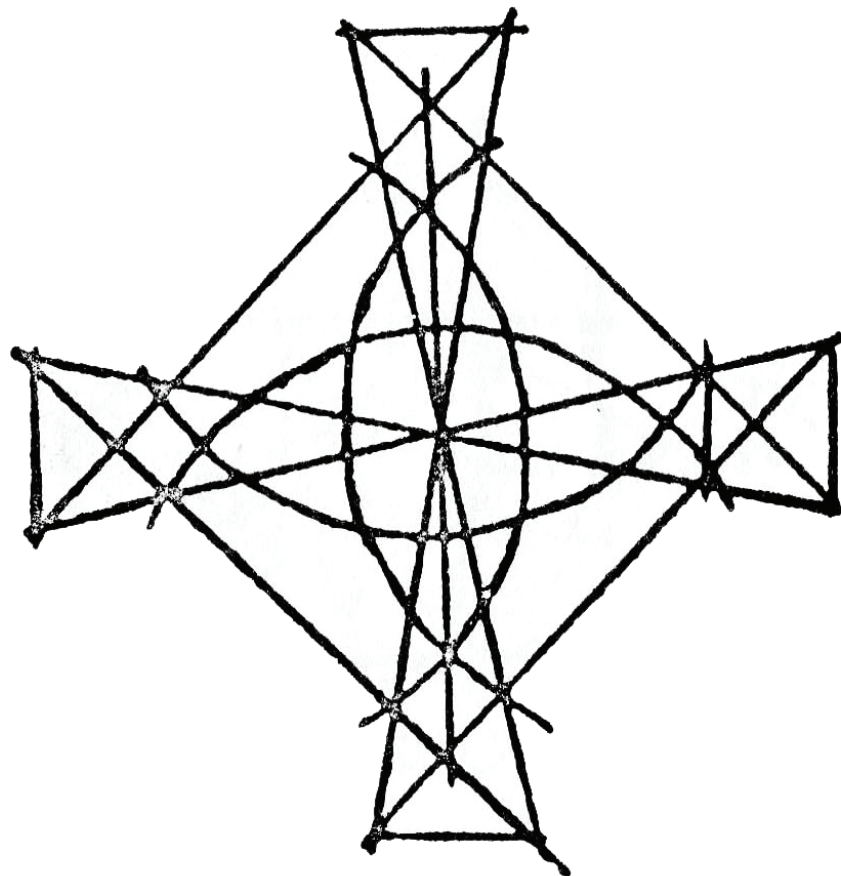


## 5 The logic of the detail

According to Gabriel Tarde, the logical potential of the sentence is more effective than the logic of the discourse. In the logic of the discourse, “panoramic illusions” are at work: illusions that neglect details in their singularity in order to construct the view of the grand ensemble. The logic of the sentence, however, departs from the singularity of the detail, the small difference of each phenomenon. It does not neglect differences or transform them into oppositions but looks at the singular from a close distance: at how one detail can be linked with the next detail in every single situation, one singularity with the next. This resembles the kind of “nonlinear editing” that a migrant is compelled to practice daily: linking heterogeneous elements in her thinking and actions, which would normally be regarded as contradictory. Transforming oppositions through the ability to adapt through continuous creation and innovation. In this way several worlds are allowed to exist simultaneously instead of being reduced to one world.

based on: Angela Melitopoulos, *Timescapes: The Logic of the Sentence*

- 6 Changing perspectives
  - 1 Exchanging one for plural



## 6

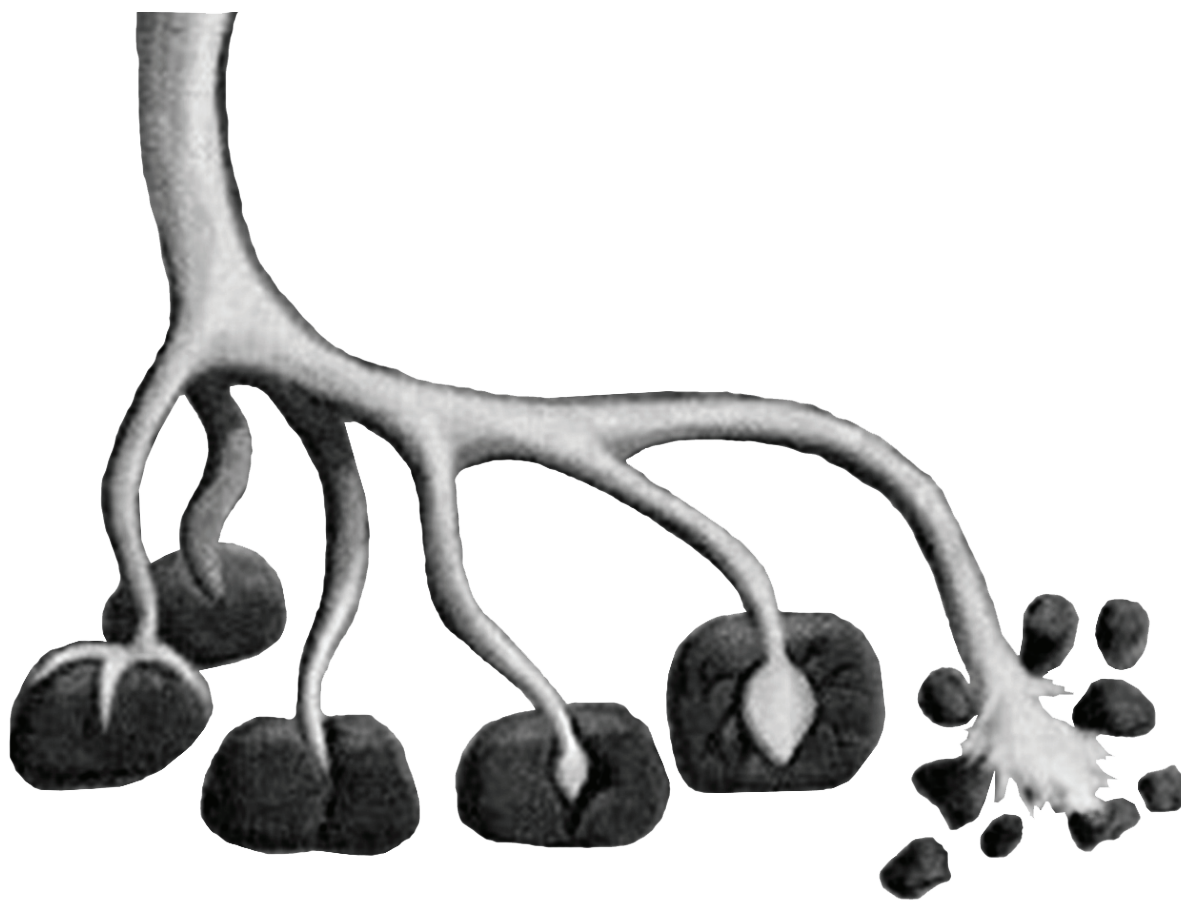
### Changing perspectives

How do you cross huge distances with no obvious physical guides? Oceans are a complex interaction of tides, currents, and wind-driven wave patterns that are replicated in cycles over time. The steepness of waves, their pattern of refraction, or the amount of cresting can all indicate location. Star configurations and their movement are markers that can be used with equal reliability. Species of birds that nest on land fly at a variety of distances from shore. Sea colors, sounds, water temperature, and phosphorescence change with depth, as do the type and variety of sea creatures that can be observed. Floating debris and smells travel in predictable patterns. This knowledge of time and space, this knowledge of mapping, is preserved verbally in stories, poems, chants, and through rhymes. It is shown physically in stick charts, in dwellings whose rafter patterns depict segments of the night sky, and in imaginary canoes surrounded by stones, which tell tales of distance and location. The grid of this chart depicts the curve, refraction, and intersection of wave patterns caused by prevailing winds. The shells tied to the frame represent the location of islands. The chart is not carried on a voyage but remembered by heart through touch.

based on: Doug Aberley, *Eye Memory: The Inspiration of Aboriginal Mapping*

► 7 Examining the basis

► 2 Negotiations in exchange



## 7

### Examining the basis

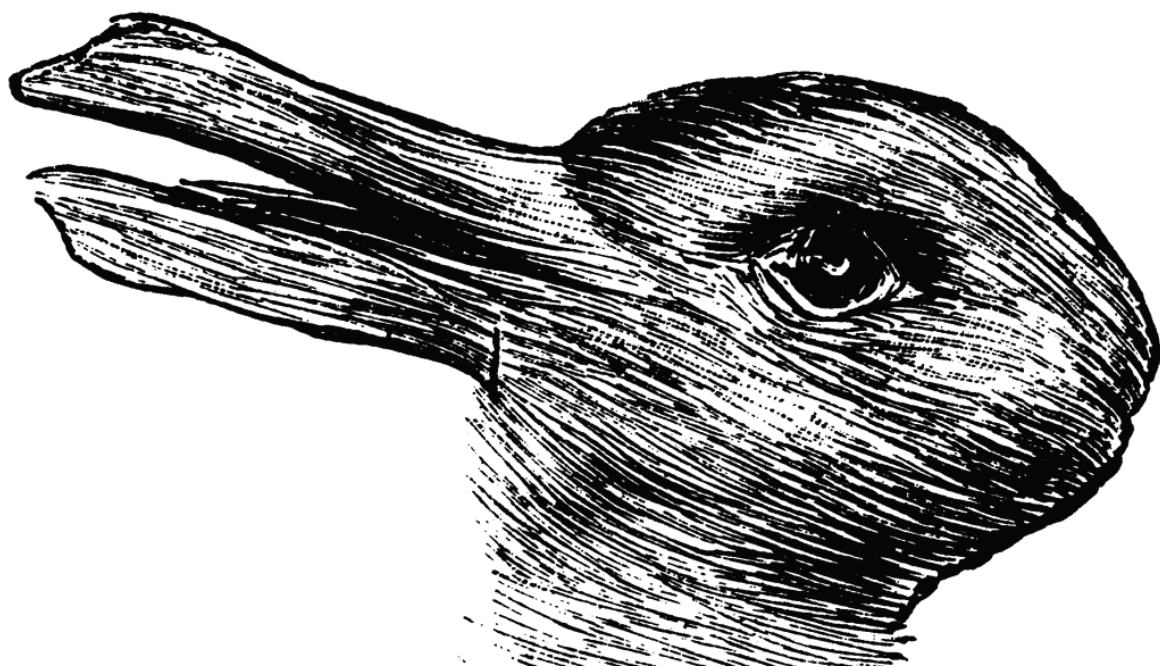
What is freedom? What is progress? Civil behavior? Law, tradition, and community? Reason, mathematics, and science? What is real, and what does it mean to be human? The concepts and categories through which the modern world has been constructed have Eurocentric thinking embedded in them.

Then: what is “philosophy”? What is “math,” “science,” “history,” “literature,” “literacy,” “humanities,” “education”? If Eurocentrism is intrinsic to the way we think and conceptualize, it is also inherent in the way we organize knowledge. More than only a conservative cultural perspective, it is the historical framework for both the production and control of knowledge. It is entrenched in the way the social sciences are structured, the concepts and categories they use for analysis, and the way progress is defined within the disciplines. We conceive, perceive, interpret, know, learn about, and (re)produce knowledge of the “world” through an ethnocentric cultural projection known as “Eurocentrism.” How can we open up a space, within the Western tradition of education, that enables us to recognize that our ways of thinking, knowing, and being are a reflection of a particular worldview, different from and similar to a variety of other equally valid and valuable ways of knowing and being?

based on: Michael Baker, Eurocentrism and the Modern/Colonial Curriculum: Towards a Post-Eurocentric Math & Science Education – A Critical Interpretive Review

► 8 Accepting two accounts to be equally valuable

► 3 Reading the world with mathematics



## 8

### Accepting two accounts to be equally valuable

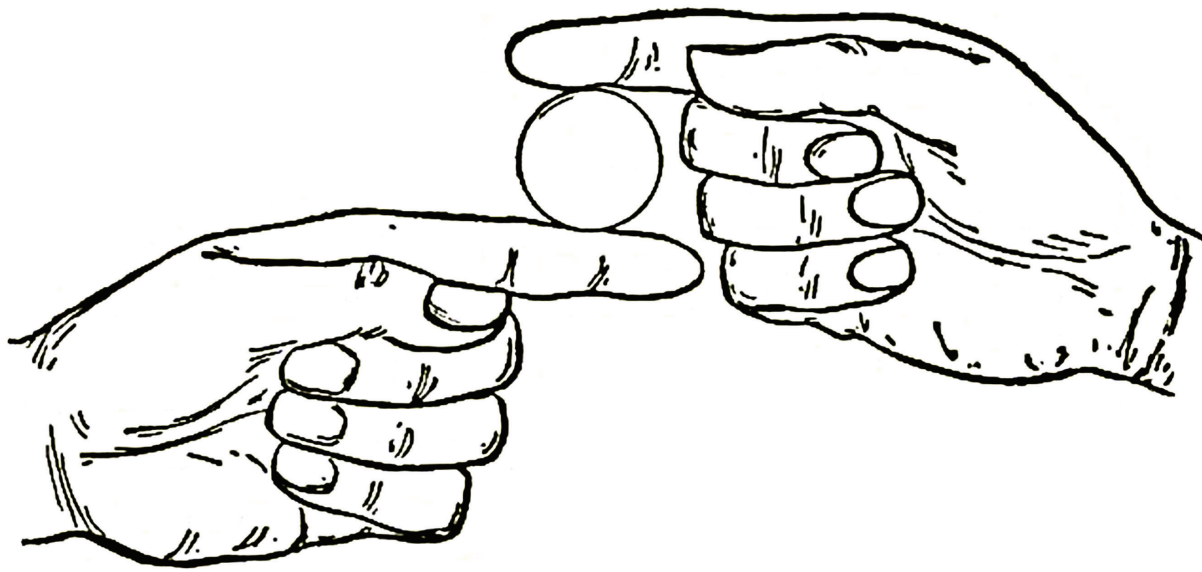
In the beginning of the twentieth century, the Wari' experienced their first real contact with European settlers. The renowned warriors had seen their enemies in the Amazonian rain forest disappear, and were delighted to resume their warfare expeditions when the Europeans finally reached their territory. According to the Wari', the new enemies arrived with peaceful intentions, ready to offer presents, and in military terms were completely incapable. They lacked guns and simulated rifle shots with slaps on their thighs, which made them easy prey.

With this account the Wari' place the Europeans in their ontology, in which predation is a core differentiating act, that momentarily separates predators and prey and classifies these two positions as human and non human, respectively. While these positions are relative, what is constant is that the Wari' experience their being in the world as inherently transformative. Although with the arrival of the colonizers transformation intensified, change  $\rightarrow$  externally induced and indigenously orchestrated – had been going on for millennia. Their deeply affirmative relation to transformation explains why the Wari' seem to have forgotten the violence that followed the initial encounter with the colonizers, and why they consider the cultural transformations set in motion by living alongside them as largely positive.

based on: Aparecida Vilaça, *Strange enemies: Indigenous Agency and Scenes of Encounters in Amazonia*

► 9 Future mathematics?

► 4 Learning in proximity



## 9

### Future mathematics?

No doubt our presence on earth implied and undeniably implies the invention of the world. The decisive step that makes us capable, both men and women, was precisely the step whereby the support where we stood became the world, and the life we lived began to become existence. And in this passage, or rather during this passage, you would never encounter a geographic border, but during this transition from the support to the world is when history begins to unfold, when culture was born . . . language, the invention of language . . . thought that not only penetrates within the object that is pondered but that is also enriched by the possibility of communication and conveyance. I believe that at this moment we have also become mathematicians. In other words, life becomes existence; life is mathematized. Mathematical comprehension could be perceived as being as important as language; therefore we need to democratize the possibility of experiencing the naturalness of mathematics. If this does not happen, how many critical intelligences, how many curiosities, how many questions, how much abstraction for concrete actions is lost? A primary concern, not only for mathematicians but for all educators who are somehow accountable for a certain amount of decisions should be this: proposing to young students that at the same time or even before they discover that  $2 \times 2 = 4$ , they should also discover a mathematical way of being in the world.

based on: Paulo Freire, interviewed by Ubiratan D'Ambrosio and Maria do Carmo Mendonça on the occasion of the 8th Congress on Mathematical Education

► 5 The logic of the detail

► 0 Fragmentizing what seems universal and continuous