Numeric palindrome: Specular quantities and recreational mathematics

A playful proposal

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2021

Chapter 1. Real limits and indeterminacies.

The idea of quantity and the concept of number is something that we come across every day. Indeed, natural numbers were one of the first things we learned in our childhood. But at some point all of us may have wondered where do the numbers come from? How do we start to use them? What was the need or needs that led our ancestors to define quantities? Well, the first men who walked on the surface of the earth appreciated their reality and "differentiated" or "distinguished" their own person from everything that surrounded them and that was part of a world that was there, in front of their eyes to be discovered, explored, organized and of which quantities and qualities could be defined, both in its extension and symbolically in order to understand it step by step. All this with the aim that primal man organize and adapt to the conditions and nature in which he was immersed. That is why man conceptualized and built a model, a scheme, an idea with which to measure his own reality and each object present in it: the number.

However, if we think about it in more detail, we may realize that we have also always felt the need to "simplify" everything we observe around us. That is not why something that is too surprising that in our childhood, in our first days in this world, we saw and saw everything as a single object, as a single warm, fun, comfortable, kind and soft uterus. At least that's what some scientists, psychologists, and pediatric physicians say about the early childhood psyche that lives and breathes in this vast universe called planet Earth.

In this first chapter, therefore, we are going to talk and play with some ideas that are surprisingly present in an underlying way in perhaps our memories? or our psychology ?, as a behind-the-scenes scenario of our daily reality, and that serves as, as we could say, perhaps "container", but that is not so evident at first glance, although it could be part without us let us realize, everything we value in our life.

If our doctors, those people we admire for their great capacity for service focused on the good health of people, including our children, have considered this idea that the baby sees his new reality as an amplification of the uterus in which everything does part of a single substance, a sea that dissolves everything in a friendly unity, full of fun and human warmth, not in vain for the baby, his mother, that sweet and benevolent giant is his everything, because from her he arose; also the water that is so essential for life is that of

which said uterus is covered from which we all arise and whose one of its most inherent qualities is fun. I think we could all agree that water is fun. Recreation could not be conceived without water.

This chapter and all the others in this book try to put one thing in the focus of the reader's attention above all: the beauty, the aesthetics of the ideas that we have used since time immemorial, these ideas are numbers, the concepts of quantities of those that we use every day and that have a very close relationship with our world, even with that world of the baby of which we have spoken, because even water, which is colorless, odorless and tasteless is measured by our numbers and as we will see it could make sense, we do draw the superficial curtain that gives us a first glimpse of numbers, quantities as an abstraction from reality. In addition, it is interesting to add if we talk about the aesthetics of these ideas, that the concept of quantity has a brother, which we could even say is its twin: quality. Quantity and quality are two ideas that are present in our thoughts without us stopping to reflect deeply on them most of the time.

Limits are aspects of reality that are part of its organization and definition, according to what our senses show us. For that reason even the boundary between our body and what is outside of it is familiar to us. It is an aspect, a fundamental law that has influenced and influences our behavior at all times. But perhaps those limits that are so evident to everyone, are not so real, or at least so palpable for a baby, as we have discussed. That is why we are going to talk about the limits that define the idea of number, as an abstraction and as a tool or device of thought, but that with a simple game we can see that these limits could be circumstantial or even diffuse when studying and playing a little with the nature of numbers, making use of a very familiar machine: the calculator.

The first thing is to think about the limit of the numbers. But if they are infinite, how can they have a limit? That is why we must make use of a gadget again, numbers as digits, because maybe in this way we can conceive a limit in something that is infinite, right?

So let's consider one-digit numbers. Which are? We all know it, they are 1, 2, 3, 4, 5, 6, 7, 8 and 9. Which is the largest? Well, the 9. What is the smallest? We would say 1. We have done it. We have discovered a limit in something that is infinite. But a question arises, between 1 and 2 we also have infinite

numbers: 1.1, 1.2, 1.3, 1.4, etc, and more between 1.1 and 1.2 we also have infinite numbers: 1.11, 1.12, 1.13, 1.14, etc, and we cannot find an ending, we could do infinite divisions even between 1.11 and 1.12. In addition, we could consider that affirming that the words “infinite” and “divisions” cannot go together because they are a contradiction, since only that which is finite can be divided; paradoxically the numbers are showing us.

The other element that is essential to talk about quantities is the idea of vacuum. How do we represent it? By means of zero. So zero is inherent in the concept of quantity, but how can it be that emptiness, nothingness, as an idea defines and is essential to be able to operate mentally with the concept of quantity? How can there be quantity in a vacuum? In fact, from the mathematics that we learned in school and that we use every day, we could not define a limit between what is something and what is nothing; even so, zero is still part of our numbers. That is why, surprisingly, something and nothing are two ideas that cannot exist without each other. Just as, if we look for more examples, in the concrete and material world, we can verify and extrapolate to the ideas of sound and silence, light and darkness or man and woman.

That is why we are going to agree that one digit numbers include zero. But it is just a convention, because the zero can accompany the numbers of a digit to its left and it is just that, a zero to the left, it can be ignored. But we can't get around it if we think of two-digit numbers, because 1 isn't the same as 10, right?

For our brain game, however, let's consider then that: the set of one-digit numbers includes zero. But then, what is the smallest number of a digit? It cannot be zero because there is no quantity in zero. So let's take the number 0.1, which has one digit because the leading zero cannot be considered as a value and because the number 0.11 would then have two digits ...

Thus, our limits are constituted by the numbers 9 and 0.1, with 9 being the largest number that we can find of a digit and 0.1 the smallest number of a digit. Now if we multiply 0.1 X 9, the result would be: 0.9; We are going to do the same with the set of two-digit numbers, whose limits, that is, the greatest quantity and the least quantity, would be respectively: 99 and 0.01; For the latter we must consider that since there is a number 1 in the second significant digit after the comma, then the zero to the right of the comma denotes quantity, right?

Now we are going to do the same with the set of numbers of three, four, five, up to fifteen digits. The result of our operations, using the calculator, to operate with three natural numbers that we have always used, zero (0), as an idea of emptiness or nothing and also as a multiplier of quantities, the number nine (9), as as much as possible and the number one (1), as the most basic concept of quantity, would then be:

Table 1. Product of limits

Number of digits	Operation	Result
One	9 x 0.1	0.9
Two	99 x 0.01	0.99
Three	999 x 0.001	0.999
Four	9999 x 0.0001	0.9999
Five	99999 x 0.00001	0.99999
Six	999999 x 0.000001	0.999999
Seven	9999999 x 0.0000001	0.9999999
Eight	99999999 x 0.00000001	0.99999999
Nine	999999999 x 0.000000001	0.999999999
Ten	9999999999 x 0.0000000001	0.9999999999
Eleven	99999999999 x 0.00000000001	0.99999999999
Twelve	999999999999 x 0.000000000001	0.999999999999
Thirteen	9999999999999 x 0.0000000000001	0.9999999999999
Fourteen	99999999999999 x 0.00000000000001	0.99999999999999
Fifteen	999999999999999 x 0.000000000000001	1

By doing this experiment on the calculator, performing each operation we obtain the results shown in Table 1. The three main ideas that make up this procedure are: to the extent that we consider the cases with more digits, the largest number in the set is extremely large, that is to say, the limit of this element is infinity? when we consider the smallest number in the set we obtain an extremely small number, and in this case when extrapolating the limit of this element it would be nothing ?; When we focus our attention on the result, the calculator, which has a limit for the number of digits that can be operated, and we get to carry out the multiplication between the highest and lowest number of fifteen digits, we obtain the result of 1.

Now if we extrapolate To synthesize our results, according to what the calculator tells us, we can describe the operations and the results obtained as follows:

The Infinite multiplied by the Nothing is equal to One.

But what does this result imply? Is the idea of quantity supported by an indeterminacy? Because infinity and nothingness are indeterminacies, since it is not possible to measure or determine what infinity is, nor is nothingness. Discrete reality, that is, based on limits, quantities and individuals, is derived and is the result of a relationship that according to the mathematics we study in school, we can describe as "infinite times nothing is equal to the quantity of one ". Perhaps that infantile reality of which we have spoken could, according to these results given by a simple calculator, not be "just an immaturity of perception".

Classroom activities:

Discuss with your students the concepts of limits for the set of numbers of units, tens, hundreds, etc. and then carry out the exercise of making the products of limit quantities for each set with the help of the calculator, in order to check these properties of the natural numbers.

Chapter 2. Palindromic numbers: correspondence, proportion and specular symmetry.

In Chapter 1 we tried to develop an introductory game of reflection about the nature of what we know and accept as quantity and what by simple mathematical association is exactly related to quantities as abstractions of material discrete physical reality.

In this second chapter we are going to begin to play with the three values that we considered earlier to delve into their mathematical relationships in school arithmetic. These three values are: the number 9 that denotes the maximum quantity within a limited set of natural numbers, that is: units, tens, hundreds, etc., the number zero as an abstract mathematical idea to operate with an empty set and also as a multiplier or threshold between the ranges of quantities that we are considering and the number 1 as the most basic reference quantity, from which the infinite values that make up the set of natural numbers and real numbers derive, and that we could say can be determined in terms of its value according to a mathematical comparison with the unit.

In mathematics, the word palindrome refers to any number that is read the same from left to right as from right to left. Examples: 11, 121, 383, 484, 888, 999, 54945. This definition implies that all base 10 numbers with a digit {0, 1, 2, 3, 4, 5, 6, 7, 8, 9} are palindromic, since they denote the same quantity no matter the sense or direction in which they are read. In this way we have that all the natural numbers of a digit are, by definition, palindromic numbers.

The first singularity derived from these ideas arises when we consider the set of two-digit or tens natural numbers. It is easy to see that the first palindromic number we come across when doing this is the number 11; It makes some logical sense to think that the first natural number that we can read in both directions when we increase the range of values to tens is unity, since as we have discussed all the values or quantities that can be thought of, derive their numerical singularity starting from a comparison with the most basic singularity that is the quantity or value of one, as a starting point of the process of differentiation and determination.