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The Nine Figures, Zero and the Position System

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Abstract

Leonardo Fibonacci in 1202 wrote in the book 'Liber Abaci', "There are the nine figures of the Indians, 987654321. With these nine figures, and with the sign 'o', which in Arabic is called Zephirum, any number can be written, as will be demonstrated." The invention of zero is of course the biggest invention in the history of the whole science. The modern system of writing numbers as a sequence of digits is so simple and convenient that we tend to take it for granted, but it is difficult to overstate the importance of this brilliant innovation. In this paper, I have tried to explain the importance of this brilliant innovation.

Introduction

Alfred North Whitehead (1861-1947) once wrote, "Before the introduction of (decimal notation) multiplication was difficult, and the division even of the integers called into play the highest mathematical faculties. Probably nothing in the modern world could have more astonished a Greek mathematician than to learn that, under the influence of compulsory education, the whole population of Western Europe, from the highest to the lowest, could perform the operation of division for the largest numbers, This fact would have seemed to him a sheer impassivity. Our modern power of easy racking with decimal fractions is the most miraculous result of a perfect notation,"

Of Couse, without the symbol for zero, the decimal notation is un-expressible. The idea that nothing can be observed as a number is rather strange and subtle concept, but it is terribly important. Indeed, it is no exaggeration to say that mathematics, and therefore science, technology and culture, could not possibly be what they are today without the number, zero, The number 'zero' as we understand it today originated in India, but historians now believe that the proper place to start the story of zero is in Ancient Mesopotamia, where a succession of civilizations used clay tables to keep numerical records. A wide range of number systems have been used over the ages, but a major advance occurred around the third dynasty (c. 2100 B.C.), when the Sumerians began to use position as part of their numerical system.

The nameless scribe who first began to use positional numeration was a real genius, and this exceptionally convenient idea is central to the modern decimal system. For example, we know that '23' represent the two lots of ten plus three, while '32' represents three lots ten plus two. These demonstrate the fact that our notation is positional, which means that changing the relative position of digits yields a different number. The same digit '3' can stand for 'three (as in '23'), thirty (as in '32' three hundred (as in '302') and so on. This contrasts with Roman numerals or the notations used by the ancient Greeks, where the symbol V always stands for five, the symbol X always stand for ten' and so on . This concludes that there is, however, one crucial difference between modern numeration and the earliest position based systems is this that they didn't have a symbol, like '0'.

The Sumerians used a system based around the number sixty, rather than ten. Indeed, the fact that we divide a circle into 360 degrees, hours into 60 minutes and minutes into 60 seconds is part of our inheritance from Mesopotians civilizations. However, for the sake of simplicity, let us consider the example provided by a Madagascan method for counting armies.

What would happen is that soldiers were led in single file, and as such one passed, a pebble was dropped into a bowl. Once the bowl contained ten pebbles it was emptied, and a single pebble would be dropped into a second bowl used for the counting groups of ten soldiers. Similarly, once the second bowl contained ten pebbles it was emptied, and a single pebble would be dropped into a third bowl used for counting groups of hundred soldiers. Now, imagine that the authorities wanted to keep a record of how the counting process had gone! This record might have read," the third bowl help six pebbles, the second bowl was empty, and the first bowl held four pebbles, "This accounts that there were six hundred and four troops, Note that whatever words or notation were used to say that the second bowl was empty played an essential role, and this role is now performed by the symbol '0'. However, counting and record keeping in this manner does not require us to think of zero as a proper number. Even when this kind of number record becomes highly abbreviated or systematized, we are not necessarily led to the concept of zero. It is remarkable to note that even though the Ancient Sumerians developed positional notation, and a symbol comprised of the two diagonal lines that worked rather like the modern '0' their system did not spread to other civilizations. This is remarkable because compared with roman numerals, positional numeration is awesomely convenient. If we multiply LXXXVII by CXI and then think how much easier it is to multiply 87 by 111. The crucial point is that Roman numerals, like the English words for numbers, have their titble connection to the working of an abacus. So, we can say that adding groups of ten is entirely akin to adding groups of ten is entirely akin to adding groups of a thousand, but this mathematical truth is not well reflected in the English language or in Roman numerals.

If we multiply a pair of numbers that are represented as Roman numerals, we cannot simply break down the problem by multiplying one digit at a time. In contrast, positional notation naturally leads to the observation that $111\times87= 8,700+870+87$.

For similar reasons, addition and subtraction are much easier with positional natation, as like an abacus, the notation shows that we can add one numeral at a time. Furthermore, positional notation makes it much easier to write large numbers, as the same numerals are used for numbers of every size. Indeed, in Roman numerals, even a numbers small as one million can be represented only by unwieldy and easily misread string of one thousand Ms.

Alexander the Great much have encountered important records that were written with positional notation, and so presumably the idea made its way back to Greece, but for the same root, as in the early thirteenth century the word 'sifr' was Latinised into 'zephirum', which was later developed into the word 'zero'.

Conclusions

'Position' is the best finding in the world of numerals. Of course, the first lines in the first paragraph of. 'Liber Abaci' by Leconardo Fibonacci are very useful & basic invention gave the most rooted knowledge for human being. Zero provides much power in such type of positions, the history of mathematics would be very different if it were not for the influence of people from Iran and Iraq. Before and after the rise of Islam, the ruling elite in that part of the world took a serious and scholarly interest in the intellectual developments of their neighbours, which included the exceptionally, sophiscated mathematicians of Constantinople, Alexandria, India and China. Their great legacy of exact science was based on a remarkably broad assessment of humanity's mathematical knowledge, with scholars searching far and wide in order to further their own intellectual interests. Number always indicates the language of the exact sciences. The history of number can best be understood as the development over many thousands of years of special way of paying attention to, talking about and solving certain kinds of problem. The problems and solutions help human beings the only creatures on the planet capable of thinking about mathematics to overcome the limitations on their activities set by the social, physical and organic environment.

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