Ancient System of Operations: Computing with Mathematical Devices

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History of Mathematics

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Abstract

What are Mathematical devices? Why are they considered ancient? What does it mean to be computing systems with these ancient devices? Throughout this study you will find out the responses to these questions that are asked by many. During ancient time man had plenty proofs and strategies to accomplishing many things, however, now over thousands of years later we discover how and when did man construct those significant findings. It iss incredible how ancient systems of operations and devices carry over into our modern technology and learning styles in today's life. Mathematicians such as John Napier, William Oughtred, and the Chinese civilizations have imprinted the roots to mathematics in a unique way.

The ancient systems of operations are recognized in numerous forms. We will be exploring some of the systems, such as, Napier's bones, Chinese Abacus and the Slide Ruler. In comparison to some of our modern mathematical devices such as the calculator and adding machines, we have a definite equivalent principle of computation. We will investigate how in ancient times, many people use different methods of calculating in contrast to the modern way of calculating mathematics, the end results are the same. It just has its own advances and logical outcomes. We look at our number system as an extremely straightforward style of learning. However, I would recommend that learning other styles of ancient operations and devices are simple as well, but yet incredibly distinctive in their own way.

In the time period of 1617, a Scottish mathematician by the name of John Napier developed many outstanding devices. One of many discoveries by John Napier was the Napier's Bones. With the development of this device, it brought forth an easier method of computing multiplication by a cycle of addition and division by a cycle of subtraction. The structure of Napier's Bones was not difficult at all. It contained a 10 × 10 table and your vertical rows being accounted as your rods. The rod starting with the multiplication symbol at the top was specifically named as your index rod and the rods with numbers (1-9) where call your rods, strips, or

X	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1									
2									
3									
4									
5									
6									
7									
8									
9									

bones. Although, this information may look and sound irrelevant but it was all true throughout John Napier's book, *Rabdology* (a term coined by him) or "Calculation with Rods." This discovery by Napier was his last and it contributed to the math universe tremendously. (Hansen, 2007). The process of his work was quite amazing. The diagram on the previous page is all they had, but it was broken up into rods (strips/bones), so they will line up their *index rods* beside their *four, five, eight, and nine rods* and analyzed the four strips as seen below. Then it turned out to appear as the following:

Multiplication using Napier's Bones

Suppose you had the following equation,

X	4	5	8	9
1				
2				
3				
4				
5				
6				
7				
8				
9				

Step 1: Arrange numbers (rods) for the multi-digit number to the right of the index rod. (4, 5, 8, and 9)

Step 2: Classify the row in place of the 1-digit number. (6)

Step 3: Write the ***sum*** of the digits in each diagonal of the row, (2, 4+3, 0+4, 8+5, and 4) from right to left and carry as needed.

Step 4: Write down the number discovered and this will be the product, or solution to the equation .

Though this is just the multiplication process of Napier's Bones, the division procedure is quite the same except with a different concept. The concept being such as the following:

Division using Napier's Bones

Suppose you had the following equation,

X	6
1	
2	
3	
4	
5	
6	
7	
8	
9	

Step 1: Arrange your rods for the six digit rod and the index rod. Take notice at you multiples of six. (6, 12, 18, 24, 30, 36, 42, 48, 54)

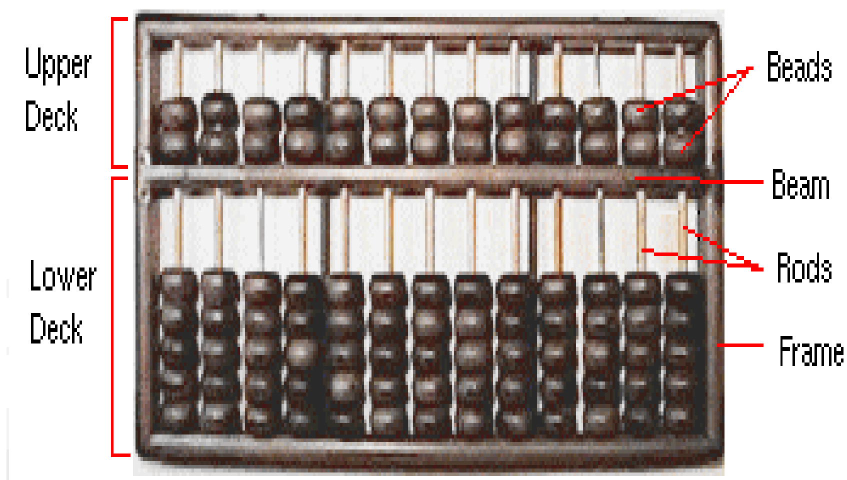
Step 2: Use the largest multiple equal to or smaller than the left-most part of the dividend, the number to be divided.

Step 3: Divide, multiply, subtract, & bring down needed numbers. Below is a more visual look:

```
     756
    ____
 6) 4536
    42
    --
     336
     30
     --
      36
      36
      --
       0
```

So, it is moderately fascinating of how little strips or rods of numbers could do so much with our modern day mathematics. In other words, John Napier was brilliant enough to invent this calculating device that not only can multiply and divide but computes square roots as well.

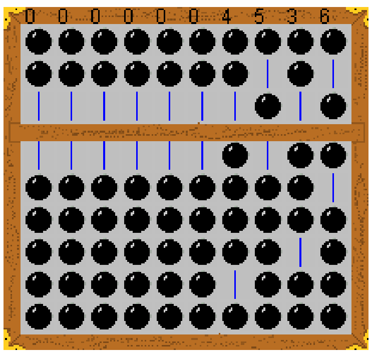
In addition to that particular development from Napier, during the era of 2600 B.C., the Chinese invented another mathematical device identified as the abacus. This additional device of the ancient world also carried a historical significance to others. Not only did China have an abacus, but many other backgrounds did as well. For instance Russians, Babylonians, Japanese, Romans, and others had their own makeup of the abacus. In earlier years there were no such things as numbers, therefore many natives made their calculations by using human resources. Primarily it was very helpful, because not only was the abacus motive towards specific mathematical viewpoints, it was initiated and used for various purposes. The abacus also brought fourth our positional notation that we use in society now. The configuration of the abacus was very easy and looked like the following:



(Brief Introduction, 2003)

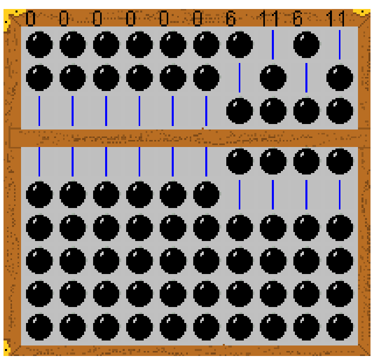
The Chinese abacus consisted of beads. The beads were located at the upper deck of the abacus (heaven beads) and the lower deck (earth beads). The heaven beads have a value of 5 and the earth beads have a value of 1. The only time the beads are considered to be counted is when they approach the beam in the middle of the abacus that separates the upper deck from lower deck. At that moment from there on everything else goes by our basic operations. Ancient mathematicians made this device so accommodating. Now by knowing the basics to the Chinese abacus infer that you have the following equations.

Addition using Chinese Abacus

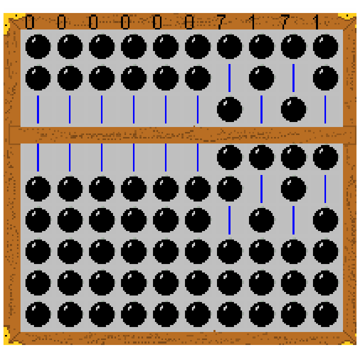


Suppose you had the following equation,

Step 1: Starting with your beads apart from the beam, now place your 4536 on the abacus.



Step 2: You will add your 2635, just as you would if adding like our modern way, except you are not using paper and pencil. However, there is too much in our ones and hundreds place so therefore we need to carry.

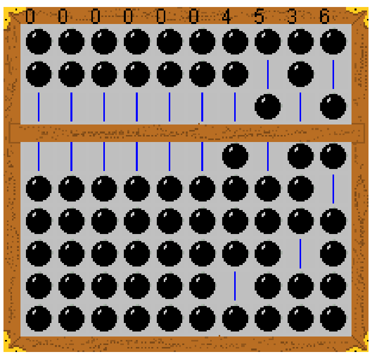


Step 3: After doing basic carrying, you will have the following 7171. In other words, this is your final solution to 4536 + 2635 = 7171 after all carrying is completed.

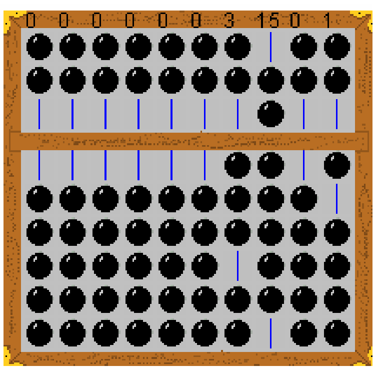
(Brief Introduction, 2003)

Subtraction using Chinese Abacus

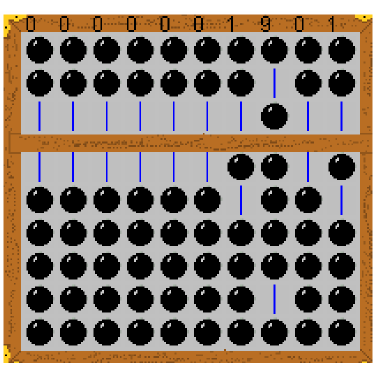
Suppose you had the following equation,



Step 1: Beginning with your heaven and earth beads away from beam, you want to place your 4536 in its correct order.



Step 2: Subtract 2635 from 4536 and you will notice that some borrowing is going to have to be set into consideration. This is because while needing to subtract 6 from 5 you need to borrow from 4 which then went to 15 subtract 6 and 3 subtract 2.

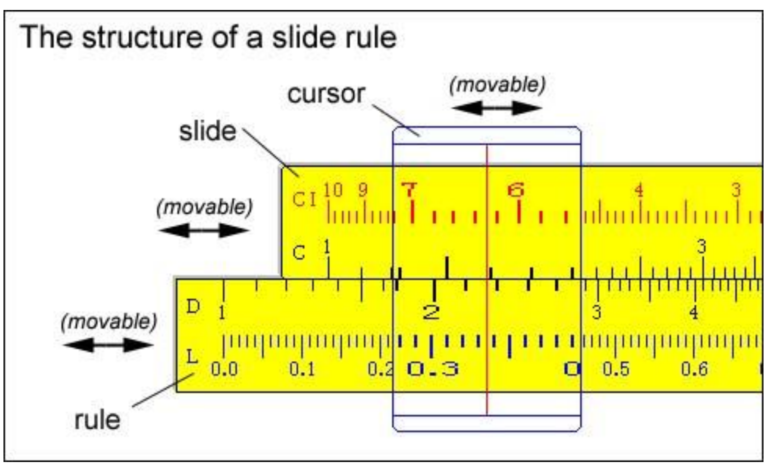


Step 3: After your previous subtracting and borrowing in Step 2 it was realized that extra steps were needed and then you came out with the final outcome of 1901.

(Brief Introduction, 2003)

The Chinese abacus as you can see was very useful to their human civilization. The counting frame was handy towards several arithmetic methods. That is why today in many countries the abacus is still used by many, such as merchants, traders, and clerks. So, taking the time to use an abacus device or to become an abacist could prove to be very beneficial. Who knows when your calculator may not work?

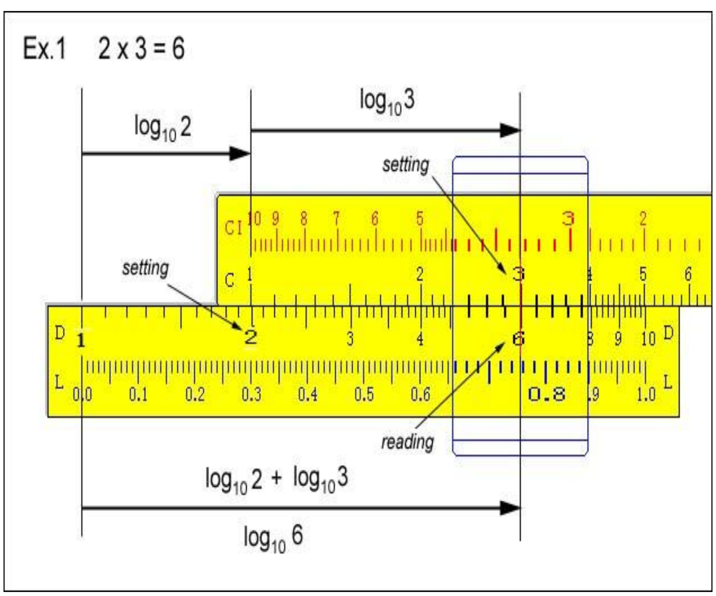
One more device used back then was one by the name of the Slide Ruler. This essential device was preceded by the logarithmic scale in 1642 by William Oughtred (1574-1660). The slide ruler in the U.S. was pursued by British forms, with specific applications to carpentry and engineering and used well into the twentieth century. A slide ruler consists of three parts: the body, the slide, and the cursor. The body and the slide are marked with scales. The cursor has a hairline that facilitates accurate positioning of the cursor at a specific point on some scale. There may be other marks on the cursor that are used for specific and special purposes. For a more visual look, here is the fundamental formation:



(Math Technology & Education)

Looking at the Slide Ruler at a glance, you get a mindset that how could this possibly be accurate, but why should it not be? It is just the significance of math and its devices. The Slide Ruler however takes a bit of time to understand fully though. You must first have a slight idea about logarithms. Then it leads to the most basic procedure of carrying out the multiplication of two numbers **u** and **v** using the **C** and **D** scales. These two scales are identical. **C** is on the slide, and **D** is on the body. Move the hairline over **u** on the **D** scale. Move the slide so that its beginning (marked by **1** on the **C** scale, and also called the **index** of the **C** scale) lines up with the hairline. Move the hairline to the number **v** on the **C** scale. Read the result underneath the hairline on the **D** scale. If the number **v** projects beyond the end of the slide ruler move the end of the slide ruler (marked with **10** on the **C** scale) above **u** and read the result as before on the **D** scale underneath the number **v** on the **C** scale. For additional purposes of understanding imagine that you have this equation:

Multiplication using the Slide Ruler

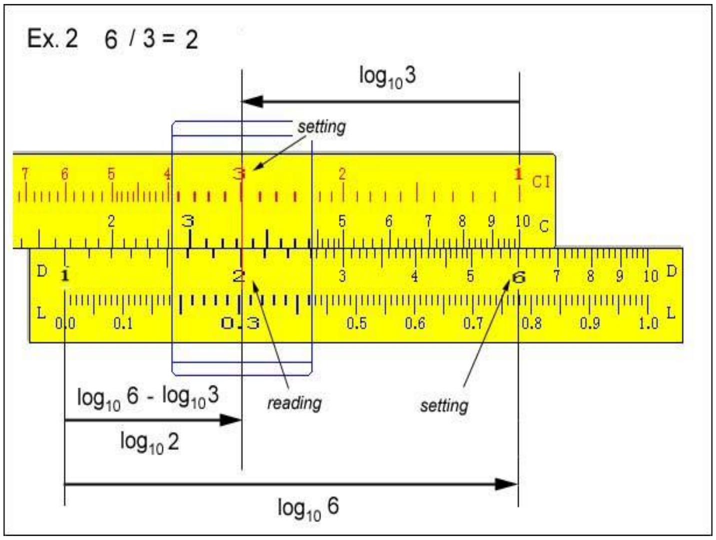


(Math Technology & Education)

Multiplication is based on the law log (axb) = log a + log b; the step to the concept of 2 × 3 = 6 is as followed:

The addition of log 2 and log 3 is carried out on the slide ruler as addition of two segments of length log 2 and log 3. The initial point 1 of the scale C is placed at point 2 of the scale D. Then the cursor is placed at the point 3 of the scale C. The product 6 is read out on the scale D.

Division using Slide Ruler



(Math Technology & Education)

Division is based on the law of log (a/b) = log a - log b and its solving of 6 / 3 = 2 is as followed:

The subtraction of log 3 from log 6 is carried out on the slide ruler as subtraction of the segment length of log 3 from that of log 6. The initial point 1 of the scale CI is placed at the point 6 of the scale D. Then the cursor is placed at the point 3 of the scale CI. The quotient 2 is read out on the scale D.

The arithmetic never seems to approach a stopping point. Without ancient mathematics, our modern mathematics would not be near the same as it is now. Thanks to our historic and bright mathematicians of the past centuries we have the ability to add, subtract, multiply, and divide. So with our world revolving around ancient mathematics in many ways, the life of math now in the 21st century can go above and beyond. However that is just the basics, we have a lot more to our math universe we can compute and we are just beginning. As a result, the origin of mathematics' history will forever stand. Math is the world, imagine the universe without numbers!

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