COUNTING & COUNTING MACHINES.

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FIRST PAPER.

Although it is impossible to say in what remote age the art of speech began, we may conjecture that the sounds first used, and the signs and gestures which would necessarily accompany them, expressed a very limited number of fundamental ideas, such, perhaps, as would indicate food, danger, etc.; and, judging from the state of language amongst the lowest types of human beings now existing, it may be taken that long ages elapsed between the utterance of the first articulate sounds and the earliest conception of the idea of number—although that of quantity would necessarily be of earlier birth. With the complex human intelligence of to-day, as we know it, it is difficult to imagine a human being with absolutely no sense of number, but it becomes more easily conceivable when we consider that such a sense is entirely absent in the lower animals. Take away one from a litter of kittens in the mother's absence, and upon her return she does not realise that there is *one less* than before. Probably her sense of quantity and locality will tell her that the space and place occupied by her progeny is less, and that there is something wanting, but she has apparently no idea that there are now, say, five kittens instead of six. There are uncivilised peoples to-day whose perception of number is limited to two, three and four, and whose ideas of quantity are simply expressed by words corresponding to "few," or "many," etc., and the entire absence of words expressing notation is not at all rare. There are races in Africa who cannot express numbers in language, even to the extent of the fingers of one hand. Dr. Peacock, early in last century, mentions the Yancos who could not count audibly beyond three because they could not express that idea by anything more simple than Poetar-rar-or-inco-aroac. The aborigines of Australia, probably the lowest in the existing human scale, cannot count beyond four. To the anthropologist the extent of knowledge of numbers possessed by different races, and their systems of verbal notation, are of great importance in forming his theories of origin and migration. A better instance could not be given than the immense difference observable between the lowly and ignorant Australian aborigine and the high intelligence of the New Zealander. Where the former have absolutely no system of notation, the latter, and indeed most of the Polynesian races, have one which, though only verbal, is as perfect as that of Europe in the tenth century, and probably the most perfect amongst uncivilised peoples of the world, a pure decimal system capable of expressing clearly and definitely any number from one to a thousand.

The earliest and most natural means of counting was by means of the fingers, and without doubt the decimal systems were originally derived from this method. The word *rima*, used to express five amongst Polynesians, also signifies the hand. Maoris call the hand *ringa*, but this is only one of the many similar slight differences in Polynesian dialects. Amongst the native Mexicans and the Caribs the same word that signifies a score means "one man," *i.e.*, ten fingers and ten toes.

There is ample evidence existing in the languages of to-day to show that the art of counting verbally, to a more or less limited extent, must have been in use from very early ages. There is not the slightest doubt that we are indebted to the far East for the introduction to the world of the science of numbers, at what time cannot be determined. History fixes neither the author nor the time, but it was not until the adaptation of signs or characters to represent numbers that the science began to assert itself and became capable of written expression.

THE EARLIEST ATTEMPT AT A COUNTING MACHINE.

Centuries before the introduction of the decimal notation to Western Europe the Chinese were proficient in the art of decimal arithmetic, and had devised a contrivance to facilitate their calculations. This invention is probably the oldest existing artificial aid to mental work, and, like many other Chinese inventions, they still use it, not only in their own country, but wherever they migrate. It is known as the Shwampan, and consists of a double series of beads sliding on fixed wires or rods. On the left hand series there are two beads on each wire, and they represent fives, whilst on the right there are five beads representing the numbers one to five. In the illustration the number indicated by the position of the beads is 7,604,823,609. It will be noticed that in this arrangement there is apparently a superfluous bead on each side of the dividing line, and any sum could be indicated by having one bead only in the left hand division, and only four in the right hand. But in the hands of the Chinese these extra beads perform important functions, and are not only used for carriage from one column to another, but for the operations of multiplication and division, so proficient are they in the use of this device.

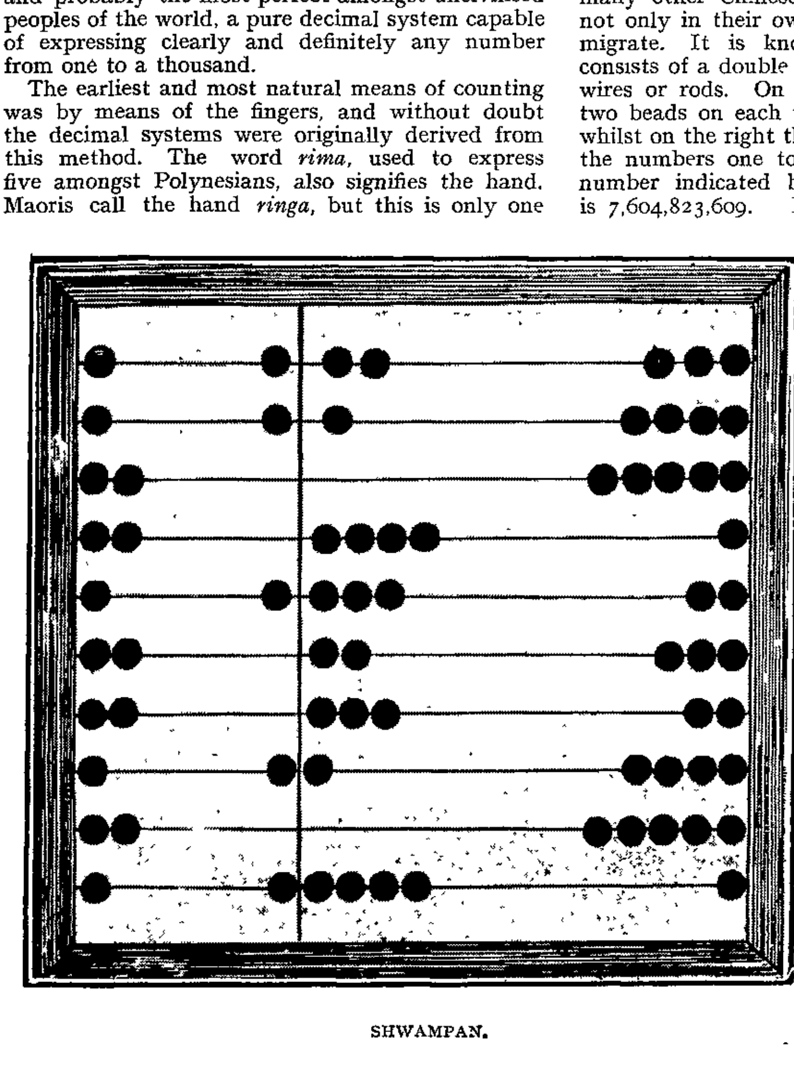
The Abacus, which derives its name from the first letters of the Greek alphabet, but which is plainly an adaptation of the Shwampan, was used in various forms by the ancients, and is used to-day in our infant schools. The form given in the illustration appears to have been one of the simplest and most generally used. It will be seen that in this device the wires contain alternately four beads and one bead. The single bead always represents five, and the others the numbers one to four. A contrivance of this kind could only be used to perform addition or subtraction, but no doubt it was enlarged or improved upon at different times until the introduction of written systems of notation supplanted it.

It was not long after the adoption of the decimal notation that the first modern contrivance for mechanical calculation made its appearance.

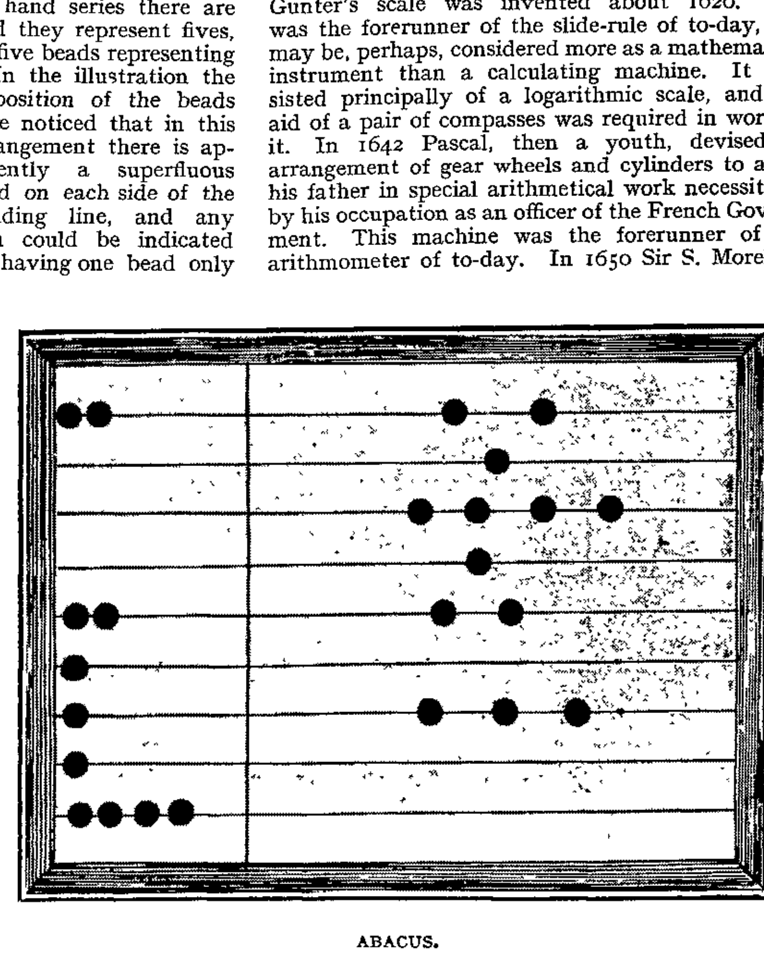
About 1614 Neper, Baron of Merchiston, in Scotland, invented his Rods, since commonly known as "Napier's" Bones. These, as shown in the illustration, consist of a series of rods, the first of which is used as an index rod. Each of the others starts at the top with a unit which is added to itself until, in the bottom division, its sum equals nine times the original number. It is really a movable multiplication table, the principal feature of which is the method of arranging the tens figure of the product on the left of the diagonal line. When it is required to multiply one number by another you place the rods so that the multiplicand appears along the top, and then entering with the unit figure of your multiplier, you set down the result, combining the right hand or lower figure in one diagonal with the left or upper one in the next rod. You then enter the table with your tens figure setting down this result beneath the first, but one figure to the left, as in ordinary multiplication, and so on. The operation of division can be performed almost as quickly as multiplication by arranging the rods to represent your divisor along the top and taking out suitable multiples thereof from the table, deducting them from the dividend, and borrowing for the remainder as in ordinary division.

To enable us to fully appreciate the value of this contrivance we must bear in mind that in those days there were very few who could perform the simplest rules of arithmetic without great labour. The system of notation was novel, and men had not only to learn the new system but to discard the old; they had to unlearn in fact, and a generation must have passed before people became in a degree familiar with the new ideas.

So soon, however, as the notation was fairly understood and taught, inventive genius was devoted towards invoking the aid of mechanics in performing the laborious operations of arithmetic. Gunter's scale was invented about 1620. This was the forerunner of the slide-rule of to-day, and may be, perhaps, considered more as a mathematical instrument than a calculating machine. It consisted principally of a logarithmic scale, and the aid of a pair of compasses was required in working it. In 1642 Pascal, then a youth, devised an arrangement of gear wheels and cylinders to assist his father in special arithmetical work necessitated by his occupation as an officer of the French Government. This machine was the forerunner of the arithmometer of to-day. In 1650 Sir S. Moreland



SHWAMPAN.



ABACUS.