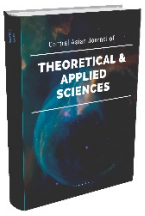

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History of the Development of the System of Values in Mathematics

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Abstract: *The article considers the history of the emergence of mathematical quantities used in the process of teaching students in the subject of mathematics. The stages of transition from simple options, the use of mathematical quantities to modern methods, the use of mathematical quantities and embedded in other subjects, are also considered.*

Keywords: *Science of values, Greek stage, beech, arrow length, cubit, arshin, span, sazhen, flywheel and oblique sazhen, inch, foot, vershok, legal inch, carat, standard, hryvnia, pood, spool, metron*

INTRODUCTION

In ancient civilizations, mainly in connection with the extensive development of trade, there was a need for measuring goods, determining distance, time, calculating crop areas and so on. At first, people measured objects by comparing them with a person or animal. However, all these measures were rather relative, because everyone has their own body proportions, and the value in mathematics is, first, accuracy. Therefore, over time, it became necessary to create a single standard of the system of quantities.

The value is considered as one of the foundations of mathematics, in particular one of its sections - geometry. This concept goes deep into the past. It was described in the III century BC. e. the ancient Greek mathematician Euclid in his work "Beginnings". People have been using quantities for over two thousand years, until they have been subject to a number of generalizations.

Quantity in mathematics is a very important topic to study in school. In fact, from the children's understanding of the value, further learning is built from simple to more and more complex. By measuring various segments and areas with a ruler, weighing mass on a scale, determining speed based on distance and time, the child gradually learns to comprehend the material world and builds his own picture of perception, and determines for himself the role of mathematics in the world around him.

A mathematical quantity is one of the basic concepts of mathematics, which means that the process of measuring a particular quantity should be carried out. More strictly, quantities are mathematical objects for which the inequality relation and addition operation can be defined, and a number of properties hold, including the axioms of Archimedes and continuity. Quantities may be constant or variable; multiple quantities may be related algebraically or otherwise.

LITERARY RESEARCH

Since ancient times, a person had to face measuring such quantities as distances, lengths of objects, time, areas, volumes, etc. Measurements were needed in construction, trade, and astronomy, in fact, in any sphere of life. Very high measurement accuracy was needed during the construction of the Egyptian pyramids. The importance of measurements increased as society developed and, in particular, as science developed. Moreover, in order to measure, it was necessary to come up with units of various physical quantities. Let us remember how it is written in the textbook: "To measure some quantity means to compare it with a homogeneous quantity taken as a unit of this quantity."

According to the source [1], it is noted that in the fifth book of the "Beginnings" the main properties of a quantity are formulated (perhaps it belongs to the pen of Eudoxus), in the seventh book the numbers are considered and a definition of the quantity is given, in the tenth book commensurable and incommensurable quantities are considered. Euclid illustrated his considerations with operations with segments, but at the same time, he considers quantities as abstract concepts. His theory is applied to angles and time. Greek mathematicians considered quantities that could be measured with a ruler of unit length and a compass.

Stevin to Hilbert [2] noted that in the 17th century, real numbers were closely associated with the concept of magnitude, and mathematics was considered the science of magnitudes.

In the work of E. A. Belyaev et al. [3], it was noted that quantities are an integral part of the content of many sciences: mathematics, physics, chemistry, astronomy, biology, etc. Without quantities, the study of nature would be limited only to observations and remain at a descriptive level. It is known, for example, that when heated, bodies expand. This phenomenon has been known since ancient times. The introduction of such quantities as temperature and volume, the establishment of the relationship between them, made it possible to significantly enrich knowledge about this phenomenon. The conditions for the introduction of this or that value mature in the process of development of a given field of knowledge, "... are created by gradual work to clarify and differentiate the concepts of experimental science".

According to A.N. Krylov [4], addition, subtraction and other arithmetic operations with latent values cannot be performed, since a one-to-one correspondence between their set and the set of real numbers cannot be established. “We must remember”, wrote Academician A. N. Krylov, “that there are many quantities”, that is, that to which the concepts of “more and“ less”are attached, but quantities that are not exactly measurable, for example, intelligence and stupidity , beauty and ugliness, courage and cowardice, resourcefulness and stupidity, etc. There are no units to measure these quantities, these quantities cannot be expressed in numbers ... ".

According to A.N. Kolmogorov [5], sometimes it should be considered that the concept of a quantity is not a special mathematical concept, since in the end, as a rule, one deals with numerical values of quantities or simply numbers. However, as Academician A. N. Kolmogorov points out, "... a completely traditional way, going back to Euclid, seems to be a more radical and correct solution: the general properties of scalar quantities are prerequisite for a systematic course in geometry ...".

In the researches of the author [6], it is noted that the concept of magnitude has not lost its significance in mathematics at the present time. Revealed in mathematics, it has a clearly expressed applied orientation. Thus, N. Ya. Vilenkin notes: "The concept of quantity is the main one when it comes to applications of mathematics"*. Modern mathematics, giving a general idea of the magnitude, distinguishes this concept from the concept of number.

METHODOLOGY

The most ancient units were subjective units. Therefore, for example, sailors measured the path with pipes, that is, the distance that the ship traveled during the time until the sailor smoked his pipe. In Spain, a similar unit was a cigar, in Japan - a horseshoe, that is, the path that a horse traveled until the straw sole tied to its hooves, which replaced the horseshoe, was worn out.

The program of the Olympic Games of Ancient Hellas included stadion (distance) running. It has been established that the Greek stage (or stages) is the length of the stadium in Olympia - 192.27 m. horizon. This time is approximately equal to two minutes ... The Romans (185 sm), the Babylonians (about 195 sm), and the Egyptians (195 sm) also had stages as a unit of distance measurement.

In Siberia, in ancient times, a measure of distance was used - beech. This is the distance at which a person ceases to see separately the horns of a bull. For many peoples, the length of the arrow was used to determine the distance - the range of the arrow. Our expressions “keep out of a gunshot”, later “on a cannon shot” are reminiscent of such units of length.

The ancient Romans measured distances in steps or double steps (left footstep, right footstep). A thousand double steps equaled a mile (Latin "mille" - a thousand).

The length of a rope or fabric is inconvenient to measure in steps or stages. For this, the units found among many peoples, identified with the names of parts of the human body, turned out to be suitable. Elbow - the distance from the end of the fingers to the elbow joint.

A measure of length for fabrics, ropes, etc. winding materials, many peoples had a double cubit. We still use this measure for a rough estimate of the length ...

In Rus', for a long time, the arshin (about 71 sm) was used as a unit of length. This measure arose during trade with eastern countries (Persians, “arsh” - cubit). Numerous expressions: “It’s like swallowing a yardstick”, “Measure on your own yardstick” and others testify to its spread.

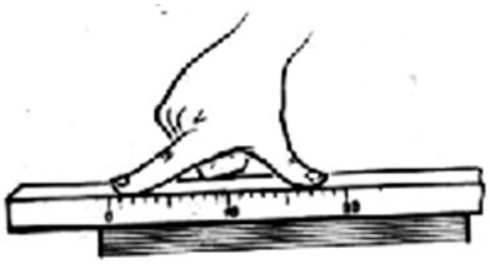

Figure 1. Drawing for measuring length (span).

To measure smaller lengths, a span was used - the distance between the ends of the spaced thumb and forefinger (Fig. 1). A span or, as it was also called, a quarter (18 cm) was 1/4 arshin, and 1/16 arshin was equal to vershok (4.4 sm).

Figure 2. Drawing illustrating the fly fathom.

A very common unit for measuring length was the fathom. The first mention of it occurs in the XI century. Since 1554, the sazhen was set equal to 3 arshins (2.13 m) and it was called royal (or eagle, printed) in contrast to arbitrary ones - flyweight and oblique. The fly fathom - the span of the arms - is approximately 2.5 arshins (Fig. 2). The angler, who shows us what a big fish he missed, shows us the flywheel.

Oblique sazhen - the distance from the end of the right arm extended upward to the toe of the left leg, it is approximately equal to 3.25 arshins.

Let us remember, as in fairy tales about giants: "A slanting sazhen in the shoulders." Surprisingly, the coincidence of the ancient Roman measure of length - the "architectural cane" and the ancient Russian oblique fathom: 248 sm. This fathom was determined by the length of the rope, one end of which was pressed with the foot to the ground, and the other was thrown over the arm of a standing person bent at the elbow and lowered again to the ground. When adding the oblique sazhen mentioned above four times, we get a "Lithuanian cubit" (62 sm).

In the countries of Western Europe, the inch (2.54 sm) has long been used as units - the length of the joint of the thumb (from the Dutch "inch" - thumb) (Fig. 3) and the foot (30 sm) - the average length of the human foot (from the English “foot” - foot) (Fig. 4).

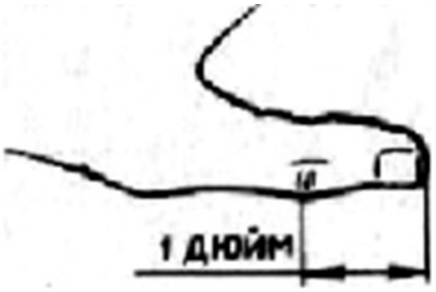

Figure 3. Inch drawing.

Figure 4. Drawing of a foot.

A cubit, a vershok, a span, a sazhen, an inch, a foot, etc. are very convenient for measurements, since they are always “at hand”. However, the units of length corresponding to the parts of the human body have a great disadvantage: different people have fingers; feet, etc. have different lengths. To get rid of arbitrariness, in the XIV century. subjective units begin to be replaced by a set of objective units. So, for example, in 1324 in England, a legal inch was established, equal to the length of three barley grains attached to each other, stretched out from the middle part of the ear (Fig. 5).

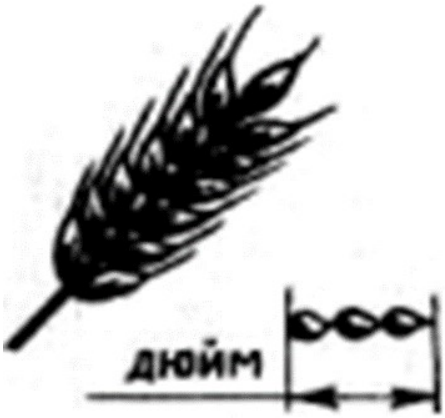

Figure 5. Drawing illustrating the size of the legalized inch.

What people and when invented the lever scales is unknown. It is possible that many peoples independently of each other did this, and the ease of use was the reason for their wide distribution. When weighing on a balance scale, the body to be weighed is placed on one cup, and the weights are placed on the other. Weights are selected to establish balance. In this case, the masses of the weighed body and weights are balanced. If the balanced scales are transferred, for example, to the Moon, where the weight of the body is 6 times less than on Earth, the balance will not be disturbed, since the weight of both the body and the weights on the Moon has decreased by the same number of times, but the mass has remained the same.

Therefore, when weighing a body on a balance scale, we determine its mass, not its weight. Units of mass, like units of length, were first established according to natural patterns. Most often by the mass of a seed. Therefore, for example, the mass of precious stones was determined and is still determined in carats (0.2 g) - this is the mass of the seed of one of the types of beans.

Later, the unit of mass was taken to be the mass of water filling a vessel of a certain capacity. For example, in ancient Babylon, talent was taken as a unit of mass - the mass of water that fills such a vessel, from which water flows evenly through a hole of a certain size for one hour.

According to the mass of grains or water, metal weights of various masses were made. They were used for weighing. Weights that served as a standard (sample) were kept in temples or government offices.

In Rus', the oldest unit of mass was the hryvnia (409.5 g). There is an assumption that this unit was imported to Russia from the East. Subsequently, she received the name of the pound. To determine large masses, a pood (16.38 kg) was used and small ones - a spool (12.8 g).

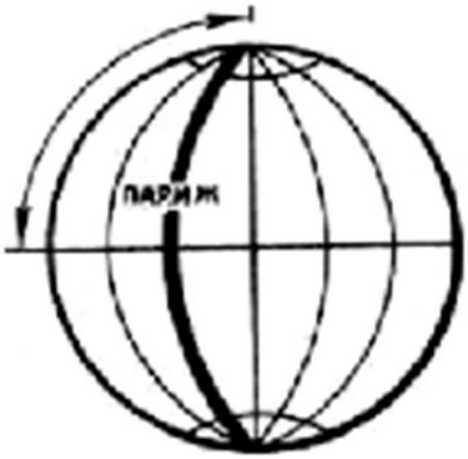

Figure 6. Drawing illustrating the measurement of the length of the meridian.

In 1791, in France, it was decided to create a decimal metric system of measures. The main quantities in this system were chosen to be length and mass. The commission, which included leading French scientists, proposed to take as a unit of length 1/40,000,000 of the length of the earth's meridian passing through Paris. The astronomers Méchain and D'Alembert were commissioned to measure the length of the meridian. The work continued for six years. The scientists measured the part of the meridian between Dunkirk and Barcelona, and then calculated the full length of the quarter meridian from the pole to the equator (Fig. 6).

Based on their data, a standard of a new unit was made from platinum. This unit was called meter - from the Greek word "metron", which means "measure".

The mass of one cubic decimeter of distilled water at the temperature of its highest density of 4°C, determined by weighing in vacuum, was taken as a mass unit. The standard of this unit, called the kilogram, was made in the form of a platinum cylinder.

In 1869, the St. Petersburg Academy of Sciences appealed to scientific institutions around the world with a call to make the decimal metric system proposed by French scientists international. This appeal also said “the achievements of science have led to the need to abandon the previous definition of the meter as 1/40,000,000 of a quarter of the length of the Parisian meridian, since later, more accurate measurements of the meridian gave different results.” In addition, it became known that the length of the meridian changes over time. However, since it was unthinkable to change the length of a meter after each meridian measurement, the St. metric system of international measures.

CONCLUUSIONS

Thus, I can note the growing role of mathematical quantities in teaching the subject of mathematics and I want to state the fact that they are already penetrating into such traditionally “non-mathematized” sciences as biology, psychology, pedagogy, sociology, etc. However, for mathematics and physics, the concept of mathematical values are the most commonly used. Therefore, I have analyzed in detail the mathematical quantities that will contribute to increasing the knowledge of students when studying the subject of mathematics.

As a conclusion, I would like to draw attention to the fact that, according to academician B.S. Jacobi (a supporter of the transformation of the metric system into an international one), from replacing the previous system of measures with a metric one, the teaching of arithmetic at school won a third of the time allotted for this subject. Accordingly, calculations in industry and trade have been greatly simplified.

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