

TO THE ORIGIN OF SEXAGESIMAL SYSTEM OF NUMERATION

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used in the astronomy and in calculations with the fractions to the XVI century.

The 60-ary system has survived from the time of the Sumerians to our days:



Sexagesimal Numeration System, well-known from the traditional clock-face, came to us from the deep Ancient Times.

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At me it always caused a sense of bewilderment.

Survive it, apparently, helped by the fact that **60** has many divisors.

But how could it arise?

Here is a quote quote from a modern course in the history of astronomy by V.G.Gorbatsky, which shares this opinion.

“Both in Sumer and Babylonia, the main occupation of population was farming ... The needs of the agricultural sector were should lead to the creation of the calendar and counting system. So ... the elements of astronomy and mathematics should were arise ... This was facilitated by existence of a well-developed system of writing (cuneiform).”

“Apparently, the cuneiform system of writing emerged in Sumer in the middle of the 4th millennium (B.C.)...

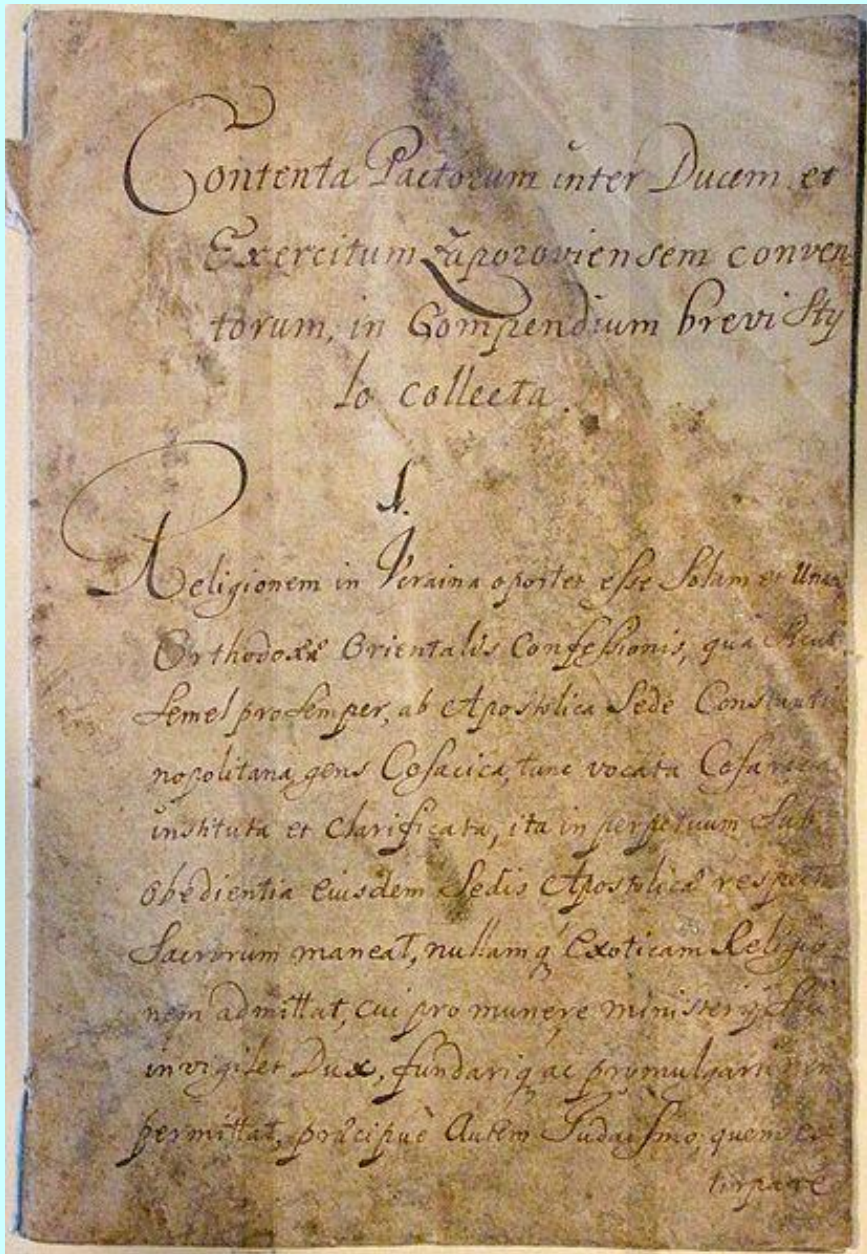
The counting system was sexagesimal, although the reason for choosing this system is not yet clear.”

“However, it was so comfortable that it used the Greek and then the Arab astronomers. ”

V.G. Gorbatsky, Lectures in the History of Astronomy. St-Pb. 2003

The answer, as I think, is very simple, though difficult to be proved

Paradoxically, in the Ukraine, we could live with the sexagesimal system of numeration!



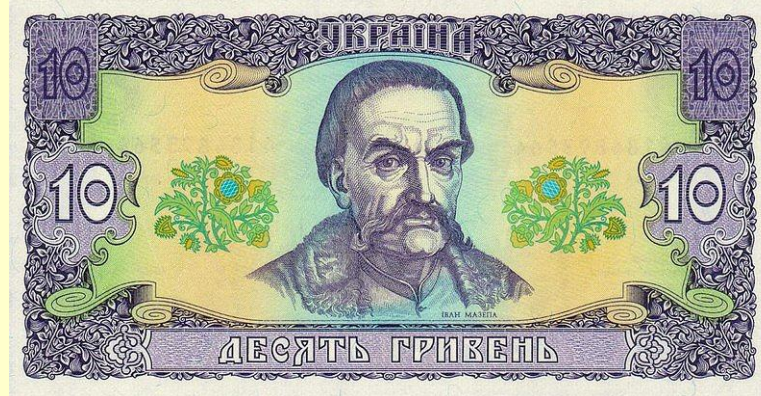
Orlik Constitution



60 **Z-75**

Getman Ivan Mazepa not fought for the Total Independence of Ukraine. In a letter to Charles XII ("Orlik Constitution") they talked on the Privileges and Liberties for Cossacks (Cossack elders) within the framework of the Swedish kingdom.

10



60

Highly symbolic image Hetman I. Mazepa on the "chervonetz" - corresponding to 10 (hryvna) - the base of the decimal system.

Meanwhile, if Mazepa and Charles XII would won the battle at Poltava, it is quite probable that we would use now the 12-ary system. Charles, on the advice of their mathematicians (and sycophants) is really going to introduce such a system in his honor*). In contrast to the base 10, which has only two divider (2 and 5), the base 12 has four divider (2, 3, 4 and 6), which is significantly more convenient.

Can be assumed that in this case with time in the number of divisors would have been added the missing five, and we would get into circulation a full 60-ary system!

But the defeat at Poltava ruined those plans.

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*) Voltaire. History of Charles XII, King of Sweden. Moscow: Limbus Press, 1999.

Z-75 Poltava



Defeat at Poltava has destroyed not only those plans. According to Swedish Ambassador in Ukraine, just after Poltava battle Sweden abandoned the imperial ambitions, at which throughout Europe them were afraid, but its own people lived poorly. How Swedes live now, we all know well.

Вдруг слабым манием руки
На русских двинул он полки.

А.С.Пушкин

A.S.Pushkin



Charles XII and Mazepa at Poltava

From the picture of G.Cederström

А потім хтів тобі Мазепа
Від серця щирого добра...
Його ж ти зрадила і степом
Пішла рабинею Петра.

В.Сосюра

“Ancient Babylonian civilization continues the tradition of the older **Sumerian** civilization. Sumerians invented cuneiform; Babylonians use it, adapting to their Semitic language...

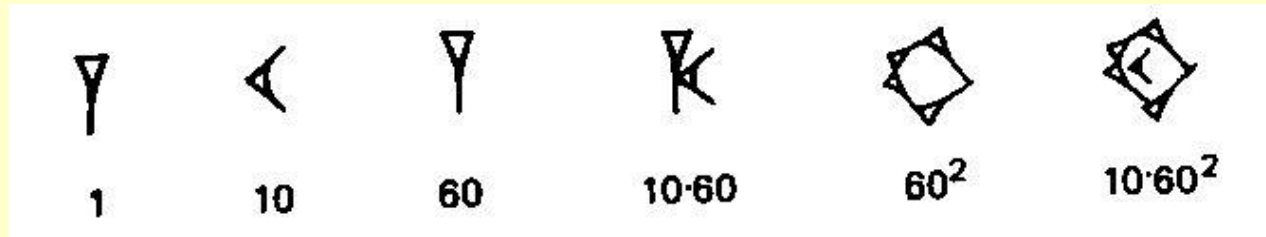
Babylonian method of writing numbers was also is borrowed from the Sumerians.

Numbers less than 60 wrote down just a repetition of characters for 10 and 1.

The Sign for 10 was a wedge, for 1 - a vertical stress. ..

For large numbers used a positional numbering system such as our decimal system, but with the base **60**. “

Van der Waerden. Awakening science. The birth of astronomy.



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What is, after all, the origin of the **60**-ary system in ancient times?

Van der Waerden believes the emergence of **60** as a radix the full random.

He is generally not very interested in the origin of a particular base and is interested in more fundamental issue - the emergence of a positional system, which has originated from the **Sumerians** at the same time.

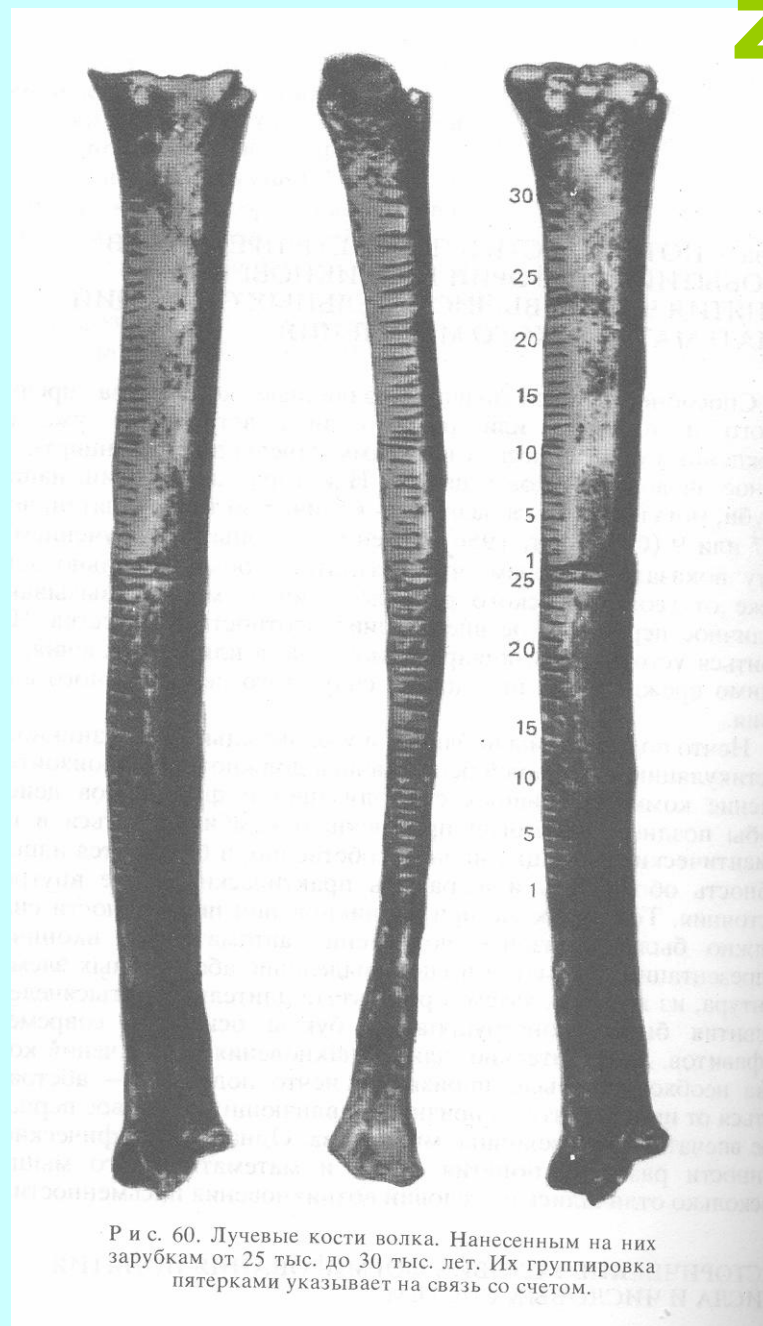
However, this does not remove the question of how to appeared the base 60.

We try to answer this question.

The oldest evidence of the grouping numbers can serve found in Moravia spoke bone (of a young wolf) with the notches, whose age estimated at 25-30 thousand years and refers to the Paleolithic.

Deep notches are grouped on five, which naturally associate with the five fingers on a hand.

F.Klix,
Erwachendes Denken



Р и с. 60. Лучевые кости волка. Нанесенным на них зарубкам от 25 тыс. до 30 тыс. лет. Их группировка пятерками указывает на связь со счетом.

1	2	3	4	5	6	8	10
I	II	III	X	IX	IIIX	XX	?
3	233	333	2333	41	2		
20	50	60	70	100	200		

The ancient Indian system **Kharoshti**.

To the 1, 4 and 10 are used the special characters.

Base **5**, **10** and **20** are most common among primitive peoples. The base **20** was among the **Maya**, the ancient **Celts**. They also naturally associated with fingertip account. But **20** is not likely to reflect the total number of fingers and toes, and is associated with a more dynamic finger accounts, which will slightly open a veil for us also in the case of the base **60**.

For example, in the ancient Indian system **Kharoshti** available three bases: **4**, **10** and **20**. Base 4 is certainly one of the oldest: 4 phases of the moon, 4 weeks in a month, four constellations in the oldest version of Zodiac Constellation confirm it. In our opinion, the base 4 leaves one free finger (the thumb), which can be used as a movable element, the counter (indicator).



Mayan inscriptions

сорок сороків Sorok Sorokov



Рис 7. Происхождение счета сорокáми; счет по суставам пальцев.

Convincing confirmation of our hypothesis we have from the evidence in favor of the connection of the **40**-ary system with fingertip account. Title in Russian language "Sorok" for "**40**" is different from the names of other multiples of 10 numbers. Its connection with antiquity emphasizes its role in oral tradition ("Soroka", "Sorok" - as a unit for measure of animal skins - "Sorok sables=forty sables" in a fur coat, etc.).

A convincing confirmation of our hypothesis is proved by the evidence in favor of the **40**-ary system of numeration with the fingertip counting. The Siberian trappers, until early 20th century, "have calculated by the thumb on the two joints of other fingers of the right hand. Counted on the right hand of 8 units (number of joints available), the counter bends a left finger. This operation of counting is ended when all fingers of the left hand are turned out to be bent. Five eights, or forty, made thus the first countable group."

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This fragment and figure is taken from the book of I. Depman "History of Arithmetic".

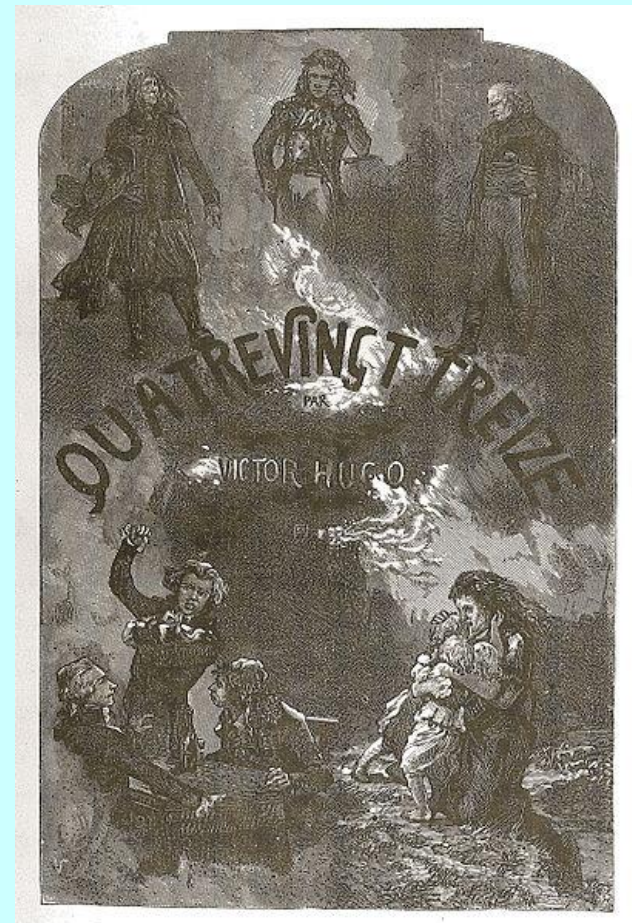
*) The counting could be conducted on the bends between the joints (VMK).

The same principle, apparently, was the basis of the **20**-ary calculus. Its traces are still visible in the French language, where recently has become topical (for us) the number '80', nobly called "four times 20 – quatre-vingt", and even becomes relevant for the forthcoming number '90' which is called "quatre-vingt-dix", i.e. four times 20 + 10. Accordingly, in the English language the same role is played by the score = 20.

Three score and fifteen = 75.

Indeed, calculating by the thumb the rest four fingers on the same hand and bending the five fingers of the other hand, we come to the base '**20**'.

Using the toes extremely uncomfortable, though could have occurred in countries where people always walk barefoot as well as the relics of the **20**-ary system.

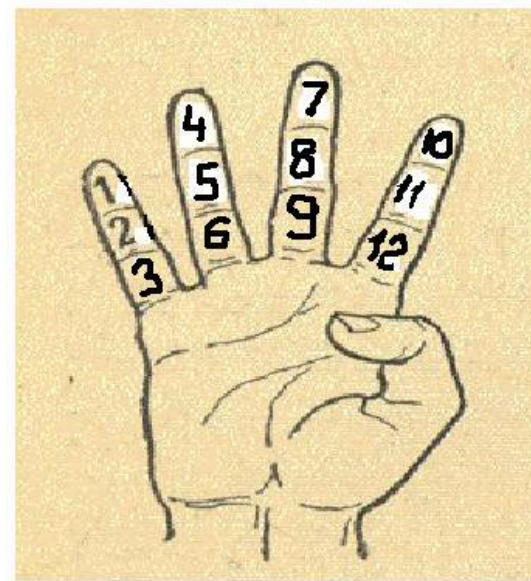


Ninety-three year
Victor Hugo



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60



As for the base '60', it arises quite naturally in this counting system, if the "counter" – thumb – counts over all three (3) phalanges the remaining 4 fingers on the same hand.

This gives 12, which itself is important and retains its role to the present day numbering (dozen; 12 months, as a combination of the lunar month and the solar year; 12 signs of the Zodiac).

In conjunction with the five fingers of the second hand, we obtain the required number of '60'.

That is, in our opinion, a natural explanation of the 60-ary calculation, rising to finger picking counting

Ode to the fiftieth birthday.

Many people ask *как много?* "Themedecem is much or few?"

I shall answer, *это, конечно*, all depends on point of view.

It is known that „fifty-fifty“, i.e. *пятьдесят на пятьдесят*

Means *всё равно* „*поровня*“ (так in English *ровно*).

Поровня of *поровня*, или „*пятьдесят*“ *одно*

Corresponds *всего лишь* - to one fourth it is *равно*.

But, still remains *каково*: three times fifty fruitful *семь*.

That is why is „fifty“ *самое - самое* *неповторимое* *счастье!*

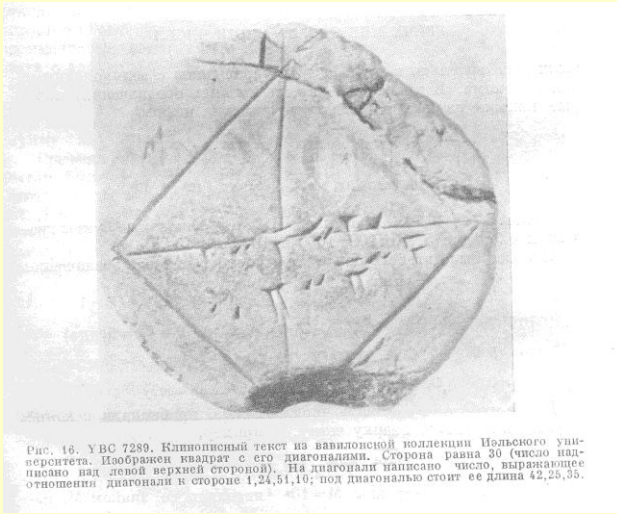
By *заставляю* let me tell you what a good friend

Many happy, many healthy, *always says:*
many joyous birthdays!

27 ноября 1981.

God of science Naboo in ancient Babylon

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I am grateful to I.A.Klimishin,
wonderful author of "History of the calendar",
which strongly supported this idea,
told him by the author on the occasion in Kiev taxi.

I also thank Pavel Bliokh
for numerous discussions and
Elena Bannikova by providing me
"History of arithmetic" of I.Depman.

Thank you for your attention!

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Three score and fifteen



Ад мэа вэ эсрим = То 120 !