

PATTERNS OF CREATING NUMERALS

I. Introduction:

It is almost a *communis opinio* that numerals belong to the most stable parts of human speech. The other *myth* is that the internal structure of numerals is analyzable only in 'primitive' languages, while the numerals in languages of the 'developed civilizations' cannot be etymologized. On the basis of etymological studies of various numerical systems, it is possible to demonstrate that concerning changes or borrowings numerals have no privileged position. At present, not only in the 'primitive' languages, but also in the 'civilized' languages the understanding of the internal structure and semantic motivation of numerals depends on the level of etymological research. The most natural source for semantic motivation is the human body, esp. the "hand" and its parts (fingers, spans, joints). Studying the numerical systems based on the body parts terminology and those with transparent internal structure reflecting the primary arithmetic operations, we can not only explain the origin of less intelligible numerals, but also find a solution of the origin of numerals in general.

II. Illustrative examples of various systems of numerals

A. Numeral systems with a transparent semantic motivation:

Telefol (Leontjev) [Trans-New-Guinean phylum of Indo-Pacific macro-phylum]

1 <i>maakub</i>	little finger of the left hand	9 <i>tukal</i>	left biceps
2 <i>alob</i>	ring-finger of the left hand	10 <i>nakalkal</i>	left shoulder
3 <i>asuno</i>	middle finger of the left hand	11 <i>kunkal</i>	left side of the neck
4 <i>kalbinim</i>	index of the left hand	12 <i>tulunkal</i>	left ear
5 <i>ookal</i>	thumb of the left hand	13 <i>tiinkal</i>	left eye
6 <i>bukubkal</i>	fist of the left hand	14 <i>mitkal</i>	nose
7 <i>bankal</i>	left forearm	15 <i>tiin miliifoko</i>	right eye
8 <i>ifankal</i>	left elbow	16 <i>tulun milifoko</i>	right ear etc.

Body part tally systems of **Kombai**, **Korowai** & **Wambon** [Trans-New Guinean phylum of Indo-Pacific macro-phylum] (compiled by Gvozdanović)

	Kombai	Korowai	Wambon	body-part
1	<i>raga</i>	<i>senan</i>	<i>sanop</i>	little finger
2	<i>ragaragu</i>	<i>senanafil</i>	<i>sanop-kunip</i>	ring finger

	Kombai	Korowai	Wambon	body-part
3	<i>woraragu</i>	<i>pinggu-(lu)p</i>	<i>takhem</i>	middle finger
4	<i>woro</i>	<i>wayafill</i>	<i>hitulop</i>	index finger
5	<i>abalo</i>	<i>wayo</i>	<i>ambalop</i>	thumb
6	<i>go</i>	<i>gedu</i>	<i>kumuk</i>	wrist
7	<i>khani</i>	<i>lafol</i>	<i>mhen</i>	lower arm
8	<i>igabu</i>	<i>bonggup</i>	<i>muyop</i>	elbow
9	<i>rafe</i>	<i>labul</i>	<i>javet</i>	upper arm
10	<i>dodou</i>	<i>main</i>	<i>malin</i>	shoulder
11	<i>ruro</i> "ear"	<i>khomofek-holol</i> "neck"	<i>nggokmit</i>	neck
12	<i>khabiya</i> "head"	<i>khotokhal</i> "ear"	<i>silutop</i>	ear
13		<i>khabean</i> "head"	<i>kelop</i>	eye

Aghu (Gvozdanović) [Trans-New Guinean phylum of Indo-Pacific macro-phylum]

	numeral	body part		numeral	body part
1	<i>fasike</i>		11	<i>kito wodo</i>	big toe
2	<i>okuomu/a</i>		12	<i>kito wodo womu</i>	toe next to the middle toe
3	<i>okuomasike</i>		13	<i>kito efe womu</i>	toe in the middle
4	<i>sigiane(mu)</i>	little finger	14	<i>kito sigia womu</i>	toe next
5	<i>bidikimu/bidikuma</i>	hand	15	<i>kito sigia</i>	little toe
	<i>bifidikimu/a</i>	the one hand		<i>kitikummu/a</i>	foot
				<i>kitifikumu/a</i>	the one foot
6	<i>bidikuma-fasike</i>	hand + one	16	<i>afi-kito wodo</i>	the other big toe
7	<i>bidikuman-okuoma</i>	hand + two	17	<i>afi-kito wodo womu</i>	the other toe next to big toe
8	<i>bidikuman-okuomasike</i>	hand + three	18	<i>afi-kito efe womu</i>	the other toe in the middle
9	<i>bidikuma-sigiane</i>	hand + little finger	19	<i>afi-kito sigia womu</i>	the other toe next to middle toe
10	<i>bidikuma-bidikuma</i>	hand + hand	20	<i>aghu-bigi</i>	person-bone

Eskimo (Thalbitzer) [Eskaleutan family of Nostratic macro-phylum]

	SW Alaska	meaning / etymology
1	<i>atauceq</i>	Al <i>ataunga</i> "I unite, join"
2	<i>malruk</i>	Gr <i>mallipa</i> "follows after him or it"
3	<i>piŋŋaijun</i>	Lb <i>pingalo</i> "round outgrowth on a tree"
4	<i>stamin</i>	WEsk <i>sitqoq</i> "knee"
5	<i>taŋŋimin</i>	NGr <i>tálljit</i> "arms"
6	<i>arFinlign</i>	WGr <i>arfaa</i> "the outer edge of his hand", cf. SWAl <i>arfirtoa</i> "I cross over to", hence "6" = *"crossing"
7	<i>malrunlign</i>	supplied with two
8	<i>piŋŋaijunlign</i>	supplied with three
9	<i>qolnnunrata</i>	ten-less
10	<i>qoln</i>	WGr <i>qulaa</i> "its upper part" etc.
11	<i>q. ataucimuk</i>	ten-one-plus; Mc <i>ataoci-itiagelaRit</i> "those that are betoed with one", cf. <i>itiGaq</i>
	<i>cipŋuku</i>	"foot"
12	<i>q. malronuk cipŋuku</i>	ten-two-plus
13	<i>q. piŋŋaijunuk</i>	ten-three-plus
	<i>cipŋuku</i>	
14	<i>akimiarutu</i>	fifteen-less
15	<i>akimiak</i>	the one at the opposite side

	SW Alaska	meaning / etymology
16	<i>a. ataucimuk cipjuku</i>	fifteen-one-plus
17	<i>a. malronuk cipjuku</i>	fifteen-two-plus
18	<i>a. piŋŋaijunuk cipjuku</i>	fifteen-three-plus
19	<i>juinanrata</i>	twenty-less
20	<i>juinok</i>	man

Al Alaska, Esk Eskimo, Gr Greenland, Lb Labrador, Mc Mackenzie, N North, S South, W West.

B. Numeral systems with a transparent application of arithmetic operations

B1. Binary systems

Jawony (Donaldson) [Gunwinyguan **Dhuwal** (Donaldson)

family of Australian macro-phylum] [Yuulngu family of Pama-Nyungan phylum]

1	<i>Λŋiŋiñ</i>		<i>wangə'ñ</i>	
2	<i>ɬakuŋaŋ</i>		<i>maaŋma</i>	
3	<i>ɬakuŋaŋ Λŋiŋiñ</i>	2 + 1	<i>juŋkun</i>	
4	<i>ɬakuŋaŋ ɬakuŋaŋ</i>	2 + 2	<i>maaŋma ga maaŋma</i>	2 + 2
5	<i>ɬakuŋaŋ ɬakuŋaŋ Λŋiŋiñ</i>	2 + 2 + 1	<i>goŋ waŋga'ñ</i>	hand-one

San (Tanaka) [Khoi-San macro-phylum]

1	<i>/wi</i>	4	<i>/am/amchira</i>	2 + 2 or 2 x 2
2	<i>/ám</i>	5	<i>tseu</i>	= "hand"
3	<i>ng'ona</i>			

Haida (Swanton) [NaDene family of Dene-Caucasian macro-phylum]

1	<i>sgoä'nsiñ</i>	
2	<i>siñ</i>	
3	<i>ɬgu'nul</i>	
4	<i>sta'nsiñ</i>	2 ²
5	<i>lë'ñ</i>	
6	<i>lga'nul</i>	dual of "3", i.e. 3 x 2
7	<i>djiŋuagä'</i>	
8	<i>sta'nnsañcha</i>	2 ³
9	<i>laa'ñiñgisgoans'iñgo</i>	10 - 1
10	<i>lä'al</i>	dual of "5", i.e. 5 x 2

Burušaski (Lorimer) & Werčikwar (Berger) [Dene-Caucasian macro-phylum]

	class I-II	III	IV	abstract	Werčikwar	comments
1	<i>hin</i>	<i>han</i>		<i>hi(k)</i>	<i>hen, han</i>	
2		<i>āita</i>	<i>āito</i>	<i>āiti, āito</i>	<i>aitān</i>	
3		<i>usko</i>		<i>Iski</i>	<i>iské</i>	
4		<i>wāito</i>		<i>wāiti, wal-</i>	<i>wāitu</i>	2 ²
5		<i>cundo</i>		<i>cindi</i>	<i>čendó</i>	
6		<i>mišindo</i>		<i>mišin(di)</i>	<i>bišindu</i>	[1] + 5
7		<i>talo</i>		<i>tale</i>	<i>thaló</i>	
8		<i>āitambo</i>		<i>āitam(bi)</i>	<i>aitāmbu</i>	2 ³
9		<i>hunčo</i>		<i>hunti</i>	<i>hučo</i>	one subtracted, cf. <i>hun</i> "1" after Hayward & Werč. -cu- "take away"
10		<i>tōrumo</i>		<i>tōrimi</i>	<i>tōrum</i>	

B1.1. In some languages the numerals are organized in pairs:

Old Japanese

1	<i>fītō</i>	2	<i>futa</i>
3	<i>mi</i>	6	<i>mu</i>
4	<i>yō</i>	8	<i>ya</i>
5	<i>i-tu</i>	10	<i>tōwo</i>

Only the numerals *nana* "7" and *kōkōnō* "9" remain without counterparts. R.A. Miller judges that "9" could represent an old multiplication "3 x 3".

Nama (Böhm) [Khoi-San macro-phylum]

Paired

1	<i>/gui</i>	2	<i>/gaw</i>
3	<i>!nona</i>	6	<i>!nani</i> but cf. <i>!Gora !nani-b</i> "thumb"
4	<i>haka</i>	8	<i>//haisa</i> dual -sa implicates "4 x 2" ?

Unpaired

7	<i>hū</i>	cf. <i>!Gora haū kh'ū</i> "7" = "4 + ?"	5	<i>koro</i>	cf. <i>kore.p</i> "palm of the hand"
9	<i>khōese khoe</i>	"man" (= 2 hands) + <i>si</i> "dorthingehen", i.e. "10 minus"	10	<i>tisi</i>	cf. <i>!Gora kisi</i> "10"; -si ~ dual -sa

B2. Ternary systems

Yukaghir of Kolyma (Jochelson) [Nostratic macro-phylum]

1	<i>irkiei</i>	
2	<i>ataxloi</i>	
3	<i>yalo</i>	
4	<i>yaloxloi</i>	3 + 1
5	<i>iñyanboi</i>	= <i>ni</i> "together" & <i>xarbo</i> "palm, wrist"

6	<i>malʷi-yaloʷi</i>	2 x 3; cf. <i>malʷi</i> "joint", Tundra Yukaghir <i>malʷur</i> "on both sides"
7	<i>purkioʷi</i>	"above two"; <i>pur</i> "above" & Tundra Yukaghir <i>kʷi</i> "2"
8	<i>malgi-yəloxoʷi</i>	2 x (3 + 1)
9	<i>kun-irki-lejoi</i>	"ten-one-not being", cf. old record of Maydell <i>kunalin irkiet oile</i>
10	<i>kunel</i>	the most archaic form is preserved in Omok <i>kinnel</i>

Yuma (Langdon & Munro) [Hoka family of Amerindian macro-phylum]

1	<i>ʔašent</i>	* <i>šiN</i>	6	<i>xuumxuuk</i>	3 x 2
2	<i>xavik</i>	* <i>xwak</i>	7	<i>paaxkʷee</i>	* <i>pa-xkʷaai</i> "them-cross over"
3	<i>xamók</i>	* <i>xmuk</i>	8	<i>siipxuuk</i>	4 x 2
4	<i>cuumpap</i>	* <i>č-xu-m-pa-p</i> , cf. Yuman * <i>xupa</i> "4" = * <i>"both twos"</i>	9	<i>xamxamok</i>	3 x 3
5	<i>saarap</i>	cf. Yuman * <i>-šalʷ</i> "hand"	10	<i>šaxxuuk</i>	* <i>ša-xuuk</i> < * <i>šalʷ</i> & * <i>xwak</i> "5 x 2"

Sumerian (Diakonoff; Dombrowski)

In Sumerian two systems of counting were used: quinary and ternary.

	Proto-Sumerian	Standard & Eblaite dialects	Emesal = ES (female dial.)	ternal count	ternal count of days
1	* <i>aš</i> * <i>diL(i)</i> * <i>gʷe</i>	<i>aš</i> <i>diš, dili</i>	<i>de</i>	<i>ge</i>	<i>be</i> (ES ?)
2	* <i>min</i> / * <i>nim</i>	<i>man, min</i>	<i>nim</i>	<i>daḡ</i> "addition"	<i>be-be</i> 1 + 1
3	* <i>eweš</i>	<i>eš</i>	<i>am(m)uš</i>	<i>PEŠ</i> "next" ?	<i>PEŠ</i>
4	* <i>lim</i>	<i>lim(m)-u</i>		<i>PEŠ-ge</i> 3 + 1 <i>PEŠ-bala</i> 3 passed	<i>PEŠ-be</i> 3 + 1
5	* <i>i(a)</i>	<i>i, ia</i>		<i>PEŠ-bala-gi</i> ₁ 3 passed + 1	<i>PEŠ-be-be</i> 3 + 1 + 1
6	* <i>i-aš(-u)</i> 5 + 1	<i>āš, a-šū</i>		<i>PEŠ-bala-gi-gi</i> ₁ 3 passed + 1 + 1	<i>PEŠ-PEŠ</i> 3 + 3
7	* <i>i-min(-u)</i> 5 + 2	<i>imin, umun</i> ₇		<i>PEŠ-PEŠ-gi</i> ₁ 3 + 3 + 1	<i>PEŠ-PEŠ-be</i> 3 + 3 + 1
8	* <i>i-eweš(-u)</i> 5 + 3	<i>ussu</i>			<i>PEŠ-PEŠ-be-be</i>
9	* <i>i-lim(-u)</i> 5 + 4	<i>ilimnu</i>			<i>PEŠ-PEŠ-PEŠ</i>
10	* <i>ḫaw(-u)</i> orig. "much"	<i>u, u-gu-wu-mu/wu</i> ₄ <i>eš</i> ₁₀			etc.
20	* <i>ni-aš</i> or * <i>[mi]n-eš</i> ₁₀	<i>niš, neš</i> 2x10			
30	* <i>eweš-ḫaw</i> or * <i>ḫaw-eweš</i>	<i>eš; ušū, ušū</i> 3x10 10x3			
40	* <i>niš-min</i>	<i>nimin, nin</i> ₃			
50	* <i>ninn-u</i> < * <i>nimin-ḫaw</i>	<i>ninnu</i> 40+10			
60		<i>giš, geš, uš</i> 2x30	<i>mu-uš</i> <i>min-eš</i>		

B3. Quaternary systems

Chumash of Santa Barbara (Dixon & Kroeber) [Hoka family of Amerindian macro-phylum]

1	<i>paka</i>	
2	<i>ickomo</i>	
3	<i>masex</i>	
4	<i>ckumu</i>	derived from "2", i.e. "22"
5	<i>yiti-paka</i>	"recur-one"
6	<i>yiti-ckomo</i>	"recur-two"
7	<i>yiti-masex</i>	"recur-three"
8	<i>malawa</i>	cf. Chumash of San Luis Obispo <i>ckomo</i> "8" related to "2" & "4"
9	<i>tspa</i>	
10	<i>kel-ckomo</i>	"plus (?) -two"
11	<i>tulu</i>	
12	<i>masex-eskumu</i>	3 x 4

B4. Quinary systems

Chukchi (Skorik) [Chukchi-Kamchatkan family of Nostratic macro-phylum]

	numeral	comments
1	<i>ynnen</i>	
2	<i>ɣire-q</i>	
3	<i>ɣyro-q</i>	
4	<i>ɣyra-q</i>	
5	<i>mytlygen</i>	"that-of-hand", cf. <i>myng-ytlyɣyn</i> "hand" + singulative
6	<i>yinnan-mytlygen</i>	1 + 5
7	<i>ɣer'a-mytlygen</i>	2 + 5
8	<i>am-ɣiroot</i>	"just-that-of-three"
9	<i>qon'a-čgyn-ken</i>	"that-of-one-[finger]-besides"
10	<i>myng-yt-ken</i>	"that-of-both-hands" (cf. dual <i>myng-yt</i> "hands")
11	<i>ynnen parol</i>	"that-of-both-hands, one redundant"
15	<i>kylgyn-ken</i>	derived from "foot"
20	<i>qlik-kin</i>	"that-of-man"
30	<i>qlik-kin myngyt-ken parol</i>	"that-of-man, that-of-both-hands redundant"
40	<i>ɣireq-qlik-kin</i>	"two-of-that-of-man"

C. Numerical systems analyzable only using etymological approach.
A mixture of the approaches A & B is evident.

Turkic (see above) [Altaic phylum of Nostratic macro-phylum]

1	* <i>bür</i>	Alt * <i>büri</i> , cf. Mo <i>büri</i> "all, each" // MKor <i>pürs</i> "at first"
2	* <i>çki</i>	< * <i>eg-(er-)</i> "to follow" + * <i>ki</i> 'ordinal suffix'
3	* <i>üč</i>	orig. perhaps "5", cf. Kyrgyz (in folklor) <i>qırqıñ usı</i> "200" = "40 x 5"; cf. Koguryō <i>üç</i> or <i>utu</i> and Japanese <i>itu</i> - "5"
4	* <i>dört</i>	cf. Chuvash <i>alä türt-čč</i> "back part of hand" (> *"four knuckles"); Mo <i>dör-ben</i> // Tg * <i>duj-gin</i> "4"

5	*bēlk	cf. Tk *bilek "wrist, forearm" // Mo bile "wrist", Ka būlkp "forearm" < *bilu-ken // Tg *bile-(ptun) "wrist" // MKor phār "arm" < *pārḥ
6	*alī	cf. Chagatai al "front side", i.e. "[1] before [5]" ?
7	*jetī	cf. Tk *jet- "to reach, be enough" ? Or cf. Mo <i>jitiger</i> "2nd"
8	*sek(k)īf	< *[e]s- (cf. Mo <i>ese</i> "not to be") + *čkki "two" + *-f 'dual marker'
9	*tokkuř	cf. Tg *togar "span; quarter (measure)" // Mo <i>töge</i> id.
10	*ōn	MKor <i>ōn</i> "100"; cf. Mo <i>ono-</i> "to count"
20	*jegirbi	cf. MMo <i>ji'ürme-de-</i> "to double" < *jīyūr- and Mo *[ø]arban "10"
30	*ottur / *oltur	Khalaj <i>hottuz</i> indicates Alt *ph-; cf. Kor <i>potāri</i> "bundle, knot"
40	*k'īrk	? < *kīrk < *čk(k)i-i-ř <i>jegirmi</i> "2 x 20", cf. Balkar <i>ēki jījirma</i> "2 x 20"
50	*el(l)ig	cf. Tk *el(l)ig "hand" and *el(l)ig "breadth of the palm of hand"
60	*alt-bī	prob. to restored in *alt-bī-ōn = (1st + 5) x 10
70	*jet-bī	prob. to restored in *jet-bī-ōn = (2nd + 5) x 10
80	*sek(k)īř ōn	8 x 10
90	*tokkuř ōn	9 x 10
100	*jūř	< Alt *yerū "the greatest [number]", cf. Mo <i>yerū</i> "the most of..", <i>yerū-dügen</i> "for the greatest part", *yer-sūn "9" // MKor <i>yōr</i> "10", <i>yōrōh</i> "a big quantity/number" // Old Japanese <i>yōrōdu</i> "10.000"

Alt Altaic, Ka Kalmyk, Kor Korean, M Middle, Mo Mongolian, Tg Tungusian, Tk Turkic.

Indo-European

Let us recapitulate the conclusions of the preceding analysis of Indo-European numerals:

*[H]oy-(wo/ko/no-) "1"	*"one (of two)"; inherited, cf. Semitic *ʔ-w-y/*ʔ-y-y "be equal"; Samoyedic *oj- "1"; Altaic *ojV "only, a single, some"
*pḥ₂- / *sem- "1"	*"togetherness"; inherited, cf. Altaic *so[m]iV "1"
*pḥ₂-wo-/mo- "1st"	*"foremost"; inherited, cf. Semitic *p-r-š "be first"; Georgian <i>pirw-el-</i> "1st"
*du-oy-H₁(u) "2"	*"2".."one of two"..'dual'; inherited, cf. Altaic *tōwi - *tūwi "2"
*H₂el-yo-/tero- "2nd"	*"another"; inherited, cf. Ugaritic <i>šl</i> "second"
*l(e)ri-/trey- "3"	*"protruding (finger)", cf. Greek <i>τέροπον</i> "end, point"
*kʷetwōr "4"	*"set of fingers" or *kʷet-wj "span", metaphorically also "number" ?, derived from *kʷet- "to stretch" > Lithuanian <i>kėsti</i> , pres. <i>kečiū</i> id. besides Russian <i>četa</i> "pair", Bulgarian <i>čet</i> "number" (= Hittite <i>kutris-</i>); Tocharian B <i>ktakāt</i> "finger gesture"
*meyu- (Anatolian) "4"	"less (hand)" or "little (finger)", cf. Greek <i>μύων</i> "little finger", <i>μείων</i> "lesser"
*penkʷe "5"	"keeps (hand in fist ?)", cf. Greek <i>παπῶν</i> "I handle" (*ppkʷ-)
*Ksweks "6"	*gʷes- "hand" + *weks- "grow" = "overgrowing hand"
< *gʷs-weks *septm "7"	< Semitic *sabʕatum "7", derived from "index", cf. Arabic <i>sibbat</i> , <i>sabʕbat</i> , <i>sabbāḥat</i> "index"; perhaps reinterpreted in the superlative *septimo- "the most honored"
H₂okto-H₁ "8"	"set of points (= fingers or knuckles of hand)" x "2" (-H₁ = dual), cf. Avestan <i>ašri-</i> "breadth of four fingers"
*H₁newm "9"	adv., orig. acc. "in lack", cf. Gothic <i>inu</i> "without"
*dekṃ & *dekṃf "10"	adv., orig. acc. "in the end" & participle "reaching, finishing", cf. Khotanese <i>dās(s)-</i> "to finish, accomplish", Greek <i>δέχθαι</i> "to take in the hand", <i>δάκτυλος</i> "finger"
*H₁wi-H₁kṃt-iH₁ "20"	< *dwi-dkṃt-iH₁ "two decads"

*k ₁ g ₁ om "100" *(s ₁ m̄-/sm̄-)/ḡ'eslo- <i>t</i> "1000" *rūs(k)ont-/g ₁ t [& *k ₁ g ₁ t̄-/y ₁ ḡ] "1000"	< *dek ₁ g ₁ d ₁ k ₁ g ₁ om "decad of decads" **"amount that can be held together in hand(s)" **"strongest [hundred]"
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Comments:

§1. The teens were usually formed as compounds, frequently without fixed order, sometimes joined by conjunctions or prepositions, cf. Greek δώδεκα / Doric δέκα δύο / Homeric δυο-καί-δεκα "12", Latin *duodecim* / Umbrian *desenduf* / Latin *decem et duo* id. etc. The teens as well as the numerals between tens have been usually transparent because of the current regularization, naturally with certain exceptions. So owing to radical changes in modern Indo-Aryan languages, these numerals represent quite unique forms (Berger 1986: 31f). On the other hand, the Baltic teens and Germanic "11" & "12" are based on the verb *leik- (~ *leip- respectively) "to leave" expressing the surplus over ten. The reconstruction of common Indo-European forms for teens is not possible, because they have probably never been firmly established.

§2. The numeral "20" is reconstructible as *H₁wiH₁k₁g₁tiH₁ < *dwi-dk₁g₁t-iH₁, via dissimilation in *ʔwidk° and a following assimilation in *ʔwiʔk° (ʔ = H₁).

For the tens 30–90 the following pattern is probably inherited:

N (= 3, 4, ..., 9) x *dkont- "decad" + coll. *-H₂ or pl. *-s.

§3. The ordinals "3rd", ..., "10th" have been interpreted as "thematic adjectives formed with *-o- from the cardinals, with zero grade of the preceding syllable" (Szemerényi 1996: 227). Concerning the primary function of the ordinals there are suggestive parallels e.g. in Kartvelian or Semitic: Georgian *sami* "3" vs. *mesame* "3rd" = *puri* "bread" vs. *mepure* "baker" (nomen agentis, cf. Benveniste 1948: 146) or Arabic (ʔal-)ḥāmisu "the fifth", formally the active participle as *qātilu* "killing" etc. (Cowgill 1970: 119). And one of the functions of the derivatives in -o- in Indo-European languages is exactly that of nomen agentis (cf. Brugmann 1906: 148, 155, 163, 608–14). Concerning the most widespread ordinal suffix -to-, Szemerényi (1960: 87) assumed the substitution -o- → -to- which could have been caused by the influence of the ordinal *dek₁g₁t-o-, reanalyzed in *dek₁g₁t-to-. This 'new' suffix was primarily transferred on the ordinal "5th" (*p₁g₁k-o- → *p₁g₁k-to-, cf. the curious Arcadian πέμπωτος remodelled after δέκοτος). On the other hand, Kuryłowicz (1964: 235) saw in -t- "a union-consonant, 'consonne de liaison' between a root-form ending in a semi-vowel and a following vocalic morph", quoting *k₁g₁-to- vs. *lik₁-o-. He added, "the ousting of -o- by -to- was regular in *dwi-, *tri-, *k₁etw₁- and was extended to the numerals five and six" (p. 237).

§4. The Indo-European system of numerals was evidently decimal. The traces of duodecimal counting in Germanic (cf. Gothic *taihuntehund*, Old Icelandic *tto tiger*, Old High German *zēhanzo* "100" = "tenty", Old Icelandic *ellefo tiger*, Old English *hundændlæftig* "110" = "eleventy", Old English *hundtwelftig* "120" = "twelfty", besides Old Icelandic *hundrað tiorött* "100",

i.e. “decimal 100”, vs. *hundrað tolfroeti* “120”, i.e. “duodecimal 100”) are derivable from the decimal system, hence they should represent a late innovation.

§5. There are also traces of vigesimal counting in various Indo-European dialects:

A. Indo-Iranian: Kati *vici* “20”, *vica-duc* “30” = “20 + 10”, *du-væcə* “40” = “2 x 20”, *du væca duc* “50” = “(2 x 20) + 10”, *trə væcə* “60” = “3 x 20”, *puč væcə* “100” = “5 x 20”, similarly Pashai *wəst* “20”, *wəst-o-dāi* “30”, *du-wya* “40”, *du-wya-u-dāi* “50”, *trā-wya* “60”, *čār-w(i)ya* “80”, *panja-wia* “100” etc. (Édel’man 1978: 286–87); Yazgulami *wast* “20”, *wast-a dūs* “30”, *δow wast* “40”, *cūy wast* “60”, *penj bist* “100” etc. (*bist* is borrowed from Tajiki), Yagnobi *bist-a das* “30”, *dū-bist* “40”, *dū nīma bist* “50” (“ $2\frac{1}{2}$ x 20”), *tīrāy-bist* “60”, *tīrāy nīma bist* “70”, *tīfór bist* “80”, *tīfór nīma bist* “90”, Ossetic Digor *dæs æma insæi* “30”, *duvinsæji* “40”, *dæs æma duvinsæji* “50”, *ærtinsæji* “60” etc., *cupparinsæji* “80”, *fonzinsæji* “100”, Baluchi *dō gīst* “40”, *sai gīst* “60”, *sai gīst u dah* “70”, *čār gīst* “80” etc. (Emmerick 1992: 312–13).

B. Romance: Modern French *soixante-dix* “70” = “60 + 10”, *quatre-vingts* “80” = “4 x 20”, *quatre-vingt-dix* “90” = “(4 x 20) + 10”, but Old French also *vint e dis* “30” = “20 + 10”, *deus vins* “40” = “2 x 20”, *trois vins* “60” = “3 x 20”, *trois vins e dis* “70” etc., further only sporadically: Wallon *quatru-vints* “80”, Franco-Provençal (Savoie) *tre vĕ* = *trois-vingts*, (Switzerland) *wī vĕ vātse* = *huit vingts vaches*, Occitan *katre vī / bins* “80”, occasionally *trés-bints* “60”, *cing bints* “100”. Outside the Gallo-Romance area the vigesimal count is well attested in Southern Italy, cf. *dua/tri/quattro vintini* in various Calabrian dialects, *du vintini* “40”, *du vintini e ddèci* “50” etc. in Sicily. The vigesimal forms occasionally also occur in Ibero-Romance: *tres vent medidas de farina* “60 measures of flour” (Berceo), *quatro vezes vinte* “4 x 20” (Tras os Montes) (Price 1992: 463–69).

C. Celtic: Middle Welsh *dec ar hugeint* “30” = “10 + 20”, Irish *daichead* “40” = “2 x 20”, Old Welsh *douceint*, Welsh *deugain*, Breton *daou-ugent* “40” = “2 x 20”, Irish *trí fichid* “60” = “3 x 20”, already Old Irish *tri fichit fer* “60 men”, Middle Welsh *triugeint*, Welsh *trigain*, Breton *tri-ugent* “60” = “3 x 20” etc. (Lewis & Pedersen 1937[54]: 238, §334.3; Price 1992: 466).

D. Germanic: Danish *halvtreds* “50”, *tres* “60”, *halvfjerds* “70”, *firs* “80”, *halvfems* “90”, Old Danish *halfhrihthætiugh* “50”, *thry(s)tiugh(æ)* “60”, *halffiærthætiugh* “70”, *fiughærtivghæ*, *firætiughæ* etc. “80”, *halffemtesintyuge* etc. “90”, *femsyndetiuge* “100” (Ross & Berns 1992: 616–19).

The presence of the vigesimal counting in Indo-European languages has been explained differently: (a) spontaneous independent innovation; (b) foreign import; (c) substratal origin (cf. the discussion in Price 1992: 466–69). The distribution of the vigesimal system is in a remarkable correlation with the existence of the non-Indo-European languages for which the vigesimal system is characteristic. The Indo-Iranian languages with the vigesimal count are spoken in the area of Hindukush and Pamir mountains where the influence of the substratal population represented by Burushaski is evident (cf. *altər*

"20", *alto wa ltər* "40", *alto wa ltər to rumo* "50", *iski a ltər* "60", *iski a ltər to rumo* "70", *walti a ltər* "80" etc. – see Lorimer 1938), or in the area of the Caucasus mountains where the influence of languages with the vigesimal system is also documented (e.g. Georgian *oci* "20", *oc-da-ati* "30", *or-m-oci* "40", *ormoc-da-ati* "50", *sam-oci* "60", *samoc-da-ati* "70", *otx-m-oci* "80", *otxmoc-da-ati* "90" or Avar *q̇q̇ogo* "20", *qi-q̇q̇ogo* "40", *qi-q̇q̇oyalda-ançgo* "50", *láb-q̇q̇ogo* "60", *láb-q̇q̇oyalda-ançgo* "70", *fan-q̇q̇ogo* "80", *fan-q̇q̇oyalda-ançgo* "90"). The presence of the vigesimal count in Romance, especially Gallo-Romance, has been explained from Gaulish. But in the known fragments of Gaulish there are no traces of the vigesimal system, cf. *tricontls* "30", *ox[oc]antia* "80" (see Olmsted 1988: 296). A much more probable source seems to be Aquitanian or other ancient language related to Basque where the vigesimal count is familiar (cf. *hoge* "20", *hoge* *eta hamar* "30", *berroge* "40", *hiruroge* "60", *lauroge* "80" etc.). The vigesimal count in the insular Celtic languages could also have been borrowed from the substratal language(s) of the British Isles, perhaps related to the pre-Indo-European languages of the Iberian peninsula and Southern France. The presence of the vigesimal system in Danish is puzzling. It could have been stimulated by contacts of the Normans with British Isles and / or Northern France. Let us mention that it were the Normans who brought the vigesimal count into Sicily and Southern Italy (Price 1992: 467).

§6. Traces of the quinary system have been sought in the numeral "10" reconstructed usually as **dekmt*, which should consist of the numeral "2" and the word "hand" (Gothic *handus* etc.) – see Szemerényi 1960: 69. In the chapter about the Indo-European numeral "10" I tried to demonstrate that this derivation is not possible (I reconstruct the forms **dek̑m* & **dek̑m̑*, seeing in them the derivatives of **dek̑-* "to reach, accomplish"); the numeral "2" cannot be reconstructed without **-u/-w-* while the vowel **-e-* in "10" never appears in any form for "2". And why is "hand" not in dual? Another attempt has to do with Old Irish *dēak* used for teens '11–19'. It was derived from hypothetical compounds: the adverb **dwi-penk̑om* or the gen. pl. in **-ōm* (Pedersen) or from the dual **dwei-penk̑ou* (Pokorny). The most convincing and elegant solution was presented by Hertz and Schrijver (Ériu 44[1993]: 181–84 with older citations) based on **dek̑m* "10" + **-k̑e* "and", i.e. the form which is absolutely logical in formation of teens. And so the only case when "10" represents demonstrably "two hands" is Ishkashim (an Iranian language from Pamir) *dl dūst* (Payne 1989: 435). But one trace of the quinary system can be identified even for the common Indo-European level. If my analysis of the numeral **Kswēks* "6" is correct (**ḡ^hs-wēks*), it represents a compound of **ḡ^hes-* "hand" & **wēks-* "to grow", hence **"overgrowing the hand"*. Unfortunately it cannot be verified on the basis of the following numeral **sept̑m*, if we accept its Semitic origin.

§7. The creation of the Indo-European numerical system could have developed according to the following scenario:

1. Judging from the external parallels, the most archaic Indo-European numerals were **[H]oy-* “one (of two)”, **sem-* “one, unit”, **du-* “two”. Applying the same criterion, the roots of the ordinals “1st” and “2nd”, viz. **p₂H₂-* and **H₂el-*, also belong here, although their primary meanings were “foremost” and “another” respectively.

2. The semantic motivation of the following numerals, “3” & “4”, was based on fingers or spans, concretely **t(e)r-i* **[finger]* “on the protruding position” → “third finger” → “three” and **k^wetw₂* **[span [consisting of four fingers ?]]* → “four” or **[set of fingers]* → “four”. The meaning **[little [finger]]* (→ “fourth [finger]” → “four”) should also be taken in account. The latter possibility can be supported by Anatolian **meyu-* “4”, probably also **[little [finger]]*, cf. Greek *μύοψ* “little finger” (Oppianus Anazarbensis, *Halieutica*). Finally, the original compound **meyu-k^wetw₂* “little finger” is also thinkable.

3. If **penk^e* “5” denoted primarily **[keeps [all fingers] in the fist]*, it would imply that the numeral “5” closed the series “1” – “5”, hence at that time the counting system was quinary. It can probably be supported by the following numeral **Kswēks* “6”, if it is derived from **ġ^hs-wēks* < **ġ^hes-* “hand” & **wēks-* “to grow”, i.e. “overgrowing the hand”.

4. The numeral **septm̄* “7” has no convincing Indo-European etymology. This fact indicates the possibility of its foreign origin. The most probable source seems to be Semitic **sabʿatum* “7”, derivable from the name of the “forefinger” (Arabic *sabābat*, *sibbat*, *sabbāhat*).

5. The numeral **H₂oktoH₁(u)* “8” represents the dual of **H₂ok[e]to-*, originally probably “set of points”, metaphorically “set of fingers”, or “set of knuckles on back of the hand”.

6. The semantic motivation of the numeral **H₁newm̄* “9”, namely “in lack” (adv.), implies its creation at the same time as the numeral “10” or even later, because it depends on the use of “10”. And finally, the numeral “10” completing the whole decad expressed **[in the end]* (adv. **dek̄m̄*), or **[reaching, accomplishing]* (participle-like **dek̄nt-*). The decimal system was complete.

7. All higher numerals less than “1000” represent compounds of the numerals of the first decad. The common pattern for tens and hundreds (with exception of Anatolian where these forms are not known) indicates that it belongs to the common (at least late) Indo-European level.

8. The highest numeral continuing at least in three Indo-European branches is “1000”. The form **(sm̄-/sm̄-)^heslo-ſi* preserved in Indo-Iranian, Greek, Italic and Celtic is older, while **tūs(k)ont-* (~ *-nt-*) **k̄ntī* (~ *-yā*) **[strong[est] hundred]* limited only to the ‘Northwest block’ is evidently innovative. It is remarkable that the common Indo-European pattern for the formation of decads is also replaced by innovations exactly in the branches of the ‘Northwest block’.

III. Conclusion:

The analyzed numerical systems demonstrate that the primary semantic motivation of numerals was based on body part names. The higher numerals originate by means of elementary arithmetic operations combining them. The limits of the used comparative-historical method depend not only on the level of our knowledge, but also on our ability to differentiate the real etymologies and the 'Volksetymologies'. The chosen examples represent only a small fragment of the incredibly rich abundance of various systems of numerals. But I believe they allow us to illustrate the difficult process of creation of numerals and counting as an attribute of modern human society in general. It is evident that numerals originated independently, on the basis of various concepts, due to imagination of generations of their creators, depending on the development of the natural and especially social environment. The creation of numerals confirms more than any other human activity that **man is a measure of himself**.

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