Patterns of creating numerals

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 *maakub*	little finger of the left hand	9 *tukal*	left biceps
2 *alob*	ring-finger of the left hand	10 *nakalkal*	left shoulder
3 *asuno*	middle finger of the left hand	11 *kumkal*	left side of the neck
4 *kalbinim*	index of the left hand	12 *tulunkal*	left ear
5 *ookal*	thumb of the left hand	13 *tiinkal*	left eye
6 *bukubkal*	fist of the left hand	14 *mitkal*	nose
7 *bankal*	left forearm	15 *tiin miliifoko*	right eye
8 *ifankal*	left elbow	16 *tulun milifoko*	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	*raga*	*senan*	*sanop*	little finger
2	*ragaragu*	*senanaful*	*sanop-kunip*	ring finger

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

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

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

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

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

	SW Alaska	meaning / etymology
16	a. ataucimuk cipʃuku	fifteen-one-plus
17	a. malronuk cipʃuku	fifteen-two-plus
18	a. piŋŋaijunuk cipʃuku	fifteen-three-plus
19	juinanrata	twenty-less
20	juinok	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	ʌnʈiŕiñ			wanga'ñ	
2	ʈatkuŕaŋ			maaŕmʌ	
3	ʈatkuŕaŋ ʌnʈiŕiñ	2 + 1		ʃuŕkʋn	
4	ʈatkuŕaŋ ʈatkuŕaŋ	2 + 2		maaŕmʌ ga maaŕmʌ	2 + 2
5	ʈatkuŕaŋ ʈatkuŕaŋ ʌnʈiŕiñ	2 + 2 + 1		gooŋ waŋga'ñ	hand-one

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

1	/wi	4	/am/amchira	2 + 2 or 2 x 2
2	/ám	5	tseu	= "hand"
3	ng!ona			

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

1	sgoã'nsiñ	
2	stiñ	
3	ʈgu'nuɬ	
4	sta'nsiñ	2^2
5	lē'il	
6	ɬgã'nuɬ	dual of "3", i.e. 3 x 2
7	djīguaɡã'	
8	sta'nnsañcha	2^3
9	laaʈi'ñgisgoansi'ñgo	10 − 1
10	lã'aɬ	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	*hin*	*han*		*hi(k)*	*hen, han*	
2		*ālta*	*ālto*	*ālti, ālto*	*altán*	
3		*usko*		*īski*	*iské*	
4		*wālto*		*wālti, wal-*	*wáltu*	2^2
5		*cundo*		*cindi*	*čendó*	
6		*mišindo*		*mišin(di)*	*bišíndu*	[1] + 5
7		*talo*		*tale*	*thaló*	
8		*āltambo*		*āltam(bi)*	*altámbu*	2^3
9		*hunčo*		*hunti*	*hučó*	one subtracted, cf. *hun* "1" after Hayward & Werč. -*cu*- "take away"
10		*tōrumo*		*tōrimi*	*tórum*	

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

Old Japanese

1	*fitö*	2	*futa*
3	*mi*	6	*mu*
4	*yö*	8	*ya*
5	*i-tu*	10	*töwo*

Only the numerals *nana* "7" and *kökönö* "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	*/gui*		2	*/gaw*	
3	*!nona*		6	*!nani*	but cf. !Gora *!nani-b* "thumb"
4	*haka*		8	*//ǂaisa*	dual -*sa* implicates "4 x 2" ?

Unpaired

7	*hũ*	cf. !Gora *haũ kḫ'ũ* "7" = "4 + ?"	5	*koro*	cf. *kore.p* "palm of the hand"
9	*kḫoese kḫoe* "man" (= 2 hands) + *si* "dorthingehen", i.e. "10 minus"		10	*tisi*	cf. !Gora *kisi* "10"; -*si* ~ dual -*sa*

B2. Ternary systems

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

1	*irkiei*	
2	*ataxloi*	
3	*yaloi*	
4	*yaloxloi*	3 + 1
5	*iṅyanboi*	= *ńi* "together" & *xańbo* "palm, wrist"

6	*malɣi-yaloi*	2 x 3; cf. *malɣi* "joint", Tundra Yukaghir *malɣur* "on both sides"
7	*purkioi*	"above two"; *pur* "above" & Tundra Yukaghir *kíji* "2"
8	*malgi-yèloxloi*	2 x (3 + 1)
9	*kun-irki-lejoi*	"ten-one-not being", cf. old record of Maydell *kunalin irkiet oile*
10	*kunel*	the most archaic form is preserved in Omok *kimnel*

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

1	*ʔašent*	**șiN*	6	*xuumxuuk*	3 x 2	
2	*xavik*	**xwak*	7	*paaxkᵞee*	**pa-xkᵞaai* "them-cross over"	
3	*xamók*	**xmuk*	8	*siipxuuk*	4 x 2	
4	*cuumpap*	**č-xu-m-pa-p*, cf. Yuman **xupa* "4" = ***"both twos"	9	*xamxamok*	3 x 3	
5	*saarap*	cf. Yuman **-șalᵞ* "hand"	10	*šaaxuuk*	**șa-xuuk* < **șalᵞ* & **xwak* "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	**aš*		*aš*			
	*diL(i)		*diš, dili*	*de*		
	*gʷe				*ge*	*be* (ES ?)
2	**min / *nim*		*man, min*	*nim*	*daḫ* "addition"	*be-be* 1 + 1
3	**eweš*		*èš*	*am(m)uš*	*PEŠ* "next" ?	*PEŠ*
4	**lim*		*lim(m)-u*		*PEŠ-ge* 3 + 1	*PEŠ-be* 3 + 1
					PEŠ-bala 3 passed	
5	**i(a)*		*i, ia*		*PEŠ-bala-gi₄*	*PEŠ-be-be*
					3 passed + 1	3 + 1 + 1
6	**i-aš(-u)*	5 + 1	*áš, a-šu*		*PEŠ-bala-giₑgi₄*	*PEŠ-PEŠ*
					3 passed + 1 + 1	3 + 3
7	**i-min(-u)*	5 + 2	*imin, umun₇*		*PEŠ-PEŠ-gi₄*	*PEŠ-PEŠ-be*
					3 + 3 + 1	3 + 3 + 1
8	**i-eweš(-u)*	5 + 3	*ussu*			*PEŠ-PEŠ-be-be*
9	**i-lim(-u)*	5 + 4	*ilimmu*			*PEŠ-PEŠ-PEŠ*
10	**ḫaw(-u)*	orig. "much"	*u, uₒ-wu-mu/wu₄* *ešₗₑ*			etc.
20	**ni-aš* or	20x1	*niš, neš*			
	*[mi]n-ešₗₑ	2x10				
30	**eweš-ḫaw* or	3x10	*eš; úšu,ùšu*			
	*ḫaw-eweš	10x3				
40	**niš-min*	20x2	*nimin, ninₛ*			
50	**ninn-u* <		*ninnu*			
	*nimin-ḫaw	40+10				
60			*giš, geš, uš*	*mu-uš*		
		2x30		*min-eš*		

B3. Quaternary systems

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

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

B4. Quinary systems

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

	numeral	comments
1	*ynnen*	
2	*ŋire-q*	
3	*ŋyro-q*	
4	*ŋyra-q*	
5	*mytlyŋen*	"that-of-hand", cf. *myng-ytlyŋyn* "hand" + singulative
6	*ynnan-mytlyŋen*	1 + 5
7	*ŋer'a-mytlyŋen*	2 + 5
8	*am-ŋiroot*	"just-that-of-three"
9	*qon'a-čgyn-ken*	"that-of-one-[finger]-besides"
10	*myng-yt-ken*	"that-of-both-hands" (cf. dual *myng-yt* "hands")
11	*ynnen parol*	"that-of-both-hands, one redundant"
15	*kylgyn-ken*	derived from "foot"
20	*qlik-kin*	"that-of-man"
30	*qlik-kin myngyt-ken parol*	"that-of-man, that-of-both-hands redundant"
40	*ŋireq-qlik-kin*	"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	*bĭr*	Alt *büri, cf. Mo *büri* "all, each" // MKor *pīrís* "at first"
2	*ekki*	< *eg-(er-)* "to follow" + *-ki* 'ordinal suffix'
3	*üč*	orig. perhaps "5", cf. Kyrgyz (in folklor) *qьrqtьn ucu* "200" = "40 x 5"; cf. Koguryŏ *üc* or *utu* and Japanese *itu-* "5"
4	*dȫrt*	cf. Chuvash *alӑ türt-ёšё* "back part of hand" (> *"four knuckles"); Mo *dör-ben* // Tg *duj-gin* "4"

5	*bēlk	cf. Tk *bilek "wrist, forearm" // Mo bile "wrist", Ka bülkŋ "forearm" < *bilü-ken // Tg *bile-(ptun) "wrist" // MKor phàr "arm" < *pàrh
6	*altï	cf. Chagatai al "front side", i.e. "[1] before [5]" ?
7	*jetti	cf. Tk *jet- "to reach, be enough" ? Or cf. Mo Jitüger "2nd"
8	*sek(k)ir	< *[e]s- (cf. Mo ese "not to be") + *ękki "two" + *-r 'dual marker'
9	*tokkur	cf. Tg *togar "span; quarter (measure)" // Mo töge id.
10	*ōn	MKor ón "100"; cf. Mo ono- "to count"
20	*jęgirbi	cf. MMo Ji'ürme-de- "to double" < *Jïγür- and Mo *[φ]arban "10"
30	*ottur / *oltur	Khalaj hottuz indicates Alt *pʰ-; cf. Kor pottàri "bundle, knot"
40	*k(')ïrk	? < *kïrk < *ęk(k)i-r jęgirmi "2 x 20", cf. Balkar ēki Jïjïrma "2 x 20"
50	*el(l)ig	cf. Tk *el(ig) "hand" and *el(l)ig "breadth of the palm of hand"
60	*alt-bïl	prob. to restored in *alt-bïl-ōn = (1st + 5) x 10
70	*jet-bïl	prob. to restored in *jet-bïl-ōn = (2nd + 5) x 10
80	*sek(k)ir ōn	8 x 10
90	*tokkur ōn	9 x 10
100	*jūr	< Alt *yerü "the greatest [number]", cf. Mo yerü "the most of..", yerü-dügen "for the greatest part", *yer-sün "9" // MKor yór "10", yòròh "a big quantity/number" // Old Japanese yòròdu "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 *?-w-y/*?-y-y "be equal"; Samoyedic *oj- "1"; Altaic *ojV "only, a single, some"
*pḷH₂- / *sem- "1"	*"togetherness"; inherited, cf. Altaic *so[m]ḷiV "1"
*pḷH₂-wo-/-mo- "1st"	*"foremost"; inherited, cf. Semitic *p-r-ʃ "be first"; Georgian pirw-el- "1st"
*du-oy-H₁(u) "2"	*"2".."one of two".."dual'; inherited, cf. Altaic *töwi ~ *tüwi "2"
*H₂el-yo-/-tero- "2nd"	*"another"; inherited, cf. Ugaritic ʃl "second"
*t(e)ri-/*trey- "3"	*"protruding (finger)", cf. Greek τέρθρον "end, point"
*kʷetwōr "4"	*"set of fingers" or *kʷet-wʃ "span", metaphorically also "number" ?, derived from *kʷet- "to stretch" > Lithuanian kèsti, pres. kečiù id. besides Russian četá "pair", Bulgarian čet "number" (= Hittite kutris-); Tocharian B ktakāt "finger gesture"
*meyu- (Anatolian) "4"	"less (hand)" or "little (finger)", cf. Greek μύων "little finger", μείων "lesser"
*penkʷe "5"	"keeps (hand in fist ?)", cf. Greek παπάω "I handle" (*pṇkʷ-)
*Ksweks "6" < *ǵʰs-weks	*ǵʰes- "hand" + *weks- "grow" = "overgrowing hand"
*septṃ "7"	< Semitic *sabʃatum "7", derived from "index", cf. Arabic sibbat, sabābat, sabbāhat "index"; perhaps reinterpreted in the superlative *septṃmo- "the most honored"
*H₂okto-H₁ "8"	"set of points (= fingers or knuckles of hand)" x "2" (*-H₁ = dual), cf. Avestan aʃti- "breadth of four fingers"
*H₁newṃ "9"	adv., orig. acc. "in lack", cf. Gothic inu "without"
*dekṃ & *dekṃt "10"	adv., orig. acc. "in the end" & participle "reaching, finishing", cf. Khotanese dāś(ś)- "to finish, accomplish", Greek δέχθαι "to take in the hand", δάκτυλος "finger"
*H₁wi-H₁kṃt-iH₁ "20"	< *dwi-dkṃt-iH₁ "two decads"

*$\hat{k}$ptom "100"	< *dek̑pt dk̑ptom "decad of decads"
*(sm̥-/smī-)ĝ'eslo-/ĩ "1000"	*"amount that can be held together in hand(s)"
*tūs(k̑)ont-/-m̥t [& *k̑pt̄/-ya̅] "1000"	*"strongest [hundred]"

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 *leik̑ʷ- (~ *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 *$H_1wiH_1k̑\mathring{p}tiH_1$ < *$dwi\text{-}dk̑\mathring{p}t\text{-}iH_1$ via dissimilation in *$?wid\hat{k}°$ and a following assimilation in *$?wi?\hat{k}°$ ($? = H_1$).

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

N (= 3, 4, .., 9) x *$d\hat{k}ont$- "decad" + coll. *-H_2 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 *(?al-)ḫāmisuⁿ* "(the) fifth", formally the active participle as *qātiluⁿ* "killing" etc. (Cowgill 1970: 119). And one of the functions of the derivatives in -o- in Indo-Europrean 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 *dek̑m̥t-o-, reanalyzed in *dek̑m̥-to-. This 'new' suffix was primarily transferred on the ordinal "5th" (*pn̥k̑ʷ-o- → *pn̥k̑ʷ-to-, cf. the curious Arcadian πέμποτος 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 *-k̑ʷr̥-to- vs. *lik̑ʷ-o-. He added, "the ousting of -o- by -to- was regular in *dwi-, *tri-, *k̑ʷetwr̥- 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 *tío 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 tirøtt* "100",

i.e. "decimal 100", vs. *hundrað tolfrøtt* "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", *ďu-vəcə* "40" = "2 x 20", *ďu vəca duc* "50" = "(2 x 20) + 10", *trə vəcə* "60" = "3 x 20", *puč vəcə* "100" = "5 x 20", similarly Pashai *wəst* "20", *wəst-o-däi* "30", *du-wya* "40", *du-wya-u-däi* "50", *trä-wya* "60", *čār-w(i)ya* "80", *panʲa-wia* "100" etc. (Édel'man 1978: 286–87); Yazgulami *wast* "20", *wast-a δǔs* "30", *δow wast* "40", *cǔy wast* "60", *penʲ bist* "100" etc. (*bist* is borrowed from Tajiki), Yaghnobi *bist-a das* "30", *dǔ-bist* "40", *dǔ níma bist* "50" ("2¹/₂ x 20"), *tīráy-bist* "60", *tīráy níma bist* "70", *tīfór bist* "80", *tīfór níma bist* "90", Ossetic Digor *dæs æma insæi* "30", *duvinsæji* "40", *dæs æma duvinsæji* "50", *ærtinsæji* "60" etc., *cupparinsæji* "80", *fonʒinsæji* "100", Baluchi *dō gīst* "40", *sai gīst* "60", *sai gīst u dah* "70", *čīār 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 vɛ* = *trois-vingts*, (Switzerland) *wī vẽ vàtse* = *huit vingts vaches*, Occitan *katre vī / bins* "80", occasionally *trés-bints* "60", *cinq 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 *halfthrithiætiugh* "50", *thry(s)tiugh(æ)* "60", *halffiærthætiwgh* "70", *fivghærtivghæ, 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", *a lto wa ltər* "40", *a lto wa ltər to rumo* "50", *i ski a ltər* "60", *i ski a ltər to rumo* "70", *wa lti 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 *q̇q̇ógo* "20", *k̇i-q̇q̇ógo* "40", *k̇i-q̇q̇oyalda-anço* "50", *λáb-q̇q̇ogo* "60", *λáb-q̇q̇oyalda-anço* "70", *ʕan-q̇q̇ogo* "80", *ʕan-q̇q̇oyalda-anço* "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. *hogei* "20", *hogei eta hamar* "30", *berrogei* "40", *hirurogei* "60", *laurogei* "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 **dekm̥t*, 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 **dekm̥* & **dekn̥t°*, 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 *dëak* used for teens '11–19'. It was derived from hypothetical compounds: the adverb **dwi-penkʷom* or the gen. pl. in **-ōm* (Pedersen) or from the dual **dwei-penkʷou* (Pokorny). The most convincing and elegant solution was presented by Hertz and Schrijver (Ériu 44[1993]: 181–84 with older citations) based on **dekm̥* "10" + **-kʷe* "and", i.e. the form which is absolutly logical in formation of teens. And so the only case when "10" represents demonstrably "two hands" is Ishkashim (an Iranian language from Pamir) *dl dûst* (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 **Ksweks* "6" is correct (**g̑ʰs-weks*), it represents a compound of **g̑ʰes-* "hand" & **weks-* "to grow", hence ***"overgrowing the hand". Unfortunately it cannot be verified on the basis of the following numeral **septm̥*, 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. *pr̥H₂ – 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 *kʷetwr̥ *"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 μύωψ "little finger" (Oppianus Anazarbensis, *Halieutica*). Finally, the original coumpound *meyu-kʷetwr̥ "little finger" is also thinkable.

3. If *penkʷe "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 *Ksweḱs "6", if it is derived from *ǵʰs-weḱs < *ǵʰes- "hand" & *weḱs- "to grow", i.e. "overgrowing the hand".

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

5. The numeral *H₂oḱtoH₁(u) "8" represents the dual of *H₂oḱ[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 *H₁newm̥ "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. *deḱm̥), or *"reaching, accomplishing" (participle-like *deḱn̥t-). 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 *(sm̥-/*smī-)ǵʰeslo-/ī preserved in Indo-Iranian, Greek, Italic and Celtic is older, while *tūs(ḱ)ont- (~ -n̥t-) *ḱn̥tī (~ -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**.

IV. References:

Benveniste, Émile, 1948: *Noms d'agent et noms d'action en indo-européen*. Paris: Maisonneuve.

Berger, Hermann, 1986: Die Zahlwörter in den neuindoarischen Sprachen. *Münchener Studien zur Sprachwissenschaft* 47, pp. 23–70.

Blažek, Václav, 1997: Altaic Numerals. *Studia Etymologica Cracoviensia* 2, pp. 33–75.

Böhm, Gerhard, 1985: *Khoe ~ Kowap. Einführung in die Sprache den Hottentoten. Nama-Dialekt*. Wien: Afro-Pub.

Brugmann, Karl, 1906: *Grundriss der vergleichenden Grammatik der indogermanischen Sprachen* 2.1. Strassburg: Trübner.

Cowgill, Warren, 1970: Italic and Celtic Superlatives and the Dialects of Indo-European. In: *Indo-European and Indo-Europeans*, eds. G. Cardona et al. Philadelphia: University of Pennsylvania Press, pp. 113–53.

Diakonoff, Igor M., 1983: Some reflections on numerals in Sumerian towards a history of mathematical speculation. *Journal of the American Oriental Society* 103, pp. 83–93.

Dixon, Roland B. & Kroeber, A.L., 1907: Numeral systems of the languages of California. *American Anthropologist* 9/4, pp. 663–90.

Dombrowski F.A. & B.W.W., 1991: Numerals and numeral systems in the Hamito-Semitic and other language groups. In: *Semitic Studies in honor of W. Leslau*, ed. A.S. Kaye. Wiesbaden: Harrassowitz, pp. 340–81.

Édel'man, D.I. 1978: Dardskie jazyki. In: *Jazyki Azii i Afriki* II. Moskva: Nauka, pp. 254–315.

Emmerick, Ronald, 1992: Iranian [numerals]. In: *IEN*, pp. 289–345.

Gvozdanović, Jadranka, 1995: Types of numeral changes. Ms.

IEN = *Indo-European Numerals*, ed. J. Gvozdanović. Berlin – New York: Mouton de Gruyter.

Jochelson, Waldemar, 1905: Essay on the grammar of the Yukaghir language. *Annals of the N.Y. Academy of Sciences*, XVI.5, II, pp. 97–152.

Kuryłowicz, Jerzy, 1964: *The inflectional categories of Indo-European*. Heidelberg: Winter.

Langdon, Margaret & Munro, Pamela, 1980: Yuman Numerals. In: *American Indian and Indo-European Studies. Papers in Honor of M.S. Beeler*. Eds. K. Klar, M. Langdon & S. Silver. Hague – Paris: Mouton, pp. 121–35.

Leontjev, A.A., 1974: *Papuasskie jazyki*. Moskva: Nauka.

Lewis, Henry & Pedersen, Holger, 1937[54]: *A concise comparative Celtic grammar*. Göttin-

gen: Vandhoeck & Ruprecht [quoted after the Russian translation *Kratkaja sravnitel'naja grammatika kel'tskix jazykov*. Moskva: Izdatel'stvo inostrannoj literatury 1954].

Lorimer, D.L.R. 1938: *The Burushaski language*, III. Oslo: Aschehoug.

Majewicz, Alfred F., 1981: Le rôle du doigt et de la main et leurs désignations dans la formation des systèmes particuliers de numération et des noms de nombres dans certaines langues. In: *La main et doigt dans l'expression linguistique* II. Ed. F. de Sivers. Paris: SELAF, pp. 193–212.

Olmsted, Garrett, 1988: The use of ordinal numerals on the Gaulish Coligny calendar. *Journal of Indo-European Studies* 16, pp. 267–339.

Payne, John, 1989: Pāmir Languages. In: *Compendium Linguarum Iranicum*. Ed. R. Schmitt. Wiesbaden: Reichert, pp. 417–44.

Price, Glanville, 1992: Romance [numerals]. In: *IEN*, pp. 447–96.

Ross, Alan S.C. & Berns, Jan, 1992: Germanic [numerals]. *IEN*, pp. 555–715.

Skorik, P.Ja., 1961: *Grammatika čukotskogo jazyka*, I. Moskva-Leningrad: Izdatel'stvo Akademii nauk SSSR.

Szemerényi, Oswald J.L. 1960: *Studies in the Indo-European system of numerals*. Heidelberg: Winter.

Szemerényi, Oswald J.L. 1996: *Introduction to Indo-European Linguistics*. Oxford: Clarendon Press.

Thalbitzer, William, 1908: The Eskimo numerals. *Journal de la Société Finno-Ougrienne* 25/2, pp. 1–25.

An overview of published parts of the book

Saharan Numerals. *Archív Orientální* 65 [1997], pp. 159–170.

Nubian Numerals in the Nilo-Saharan Context. *Archív Orientální* 66 [1998], pp. 331–344.

Egyptian Numerals. In: *Proceedings of the 9ᵗʰ Italian Meeting of Afroasiatic (Hamito-Semitic) Linguistics* (Trieste, Apr 1998), eds. M. Lamberti & L. Tonelli.

Berber Numerals. *Archív Orientální* 66 [1998], pp. 149–168.

Kartvelian Numerals. *Georgica* 21 [1998].

Some thoughts about Uralic numerals. *Philologica Fenno-Ugrica* 2–3 [1996–97], pp. 1–18.

Uralic Numbers. *Dhumbadji! Journal for the History of Language* 4.1 [1998], pp. 3–16.

Altaic Numerals. *Studia Etymologica Cracoviensia* 2 [1997], pp. 33–75.

Indo-European "two". *Sborník prací Filosofické fakulty Brněnské university* A 46 [1998], pp. 5–25.

Indo-European "three". *Lingua Posnaniensis* 40 [1998].

Indo-European "four". *Indogermanische Forschungen* 103 [1998], pp. 112–134.

Indo-European "seven". In: *Indo-European, Nostratic, and Beyond: Festschrift for Vitalij V. Shevoroshkin*, eds. I. Hegedüs, P. A. Michalove & A. Manaster Ramer, pp. 9–29.

Indo-European "eight". *Historische Sprachforschung* 111 [1998], pp. 209–224.