Symbology Overview

by michael de vlieger

A good first step in the consideration of systems of numerals for dozenal and other number bases is reviewing and classifying all systems. "The Opposed Principles" which Ralph "Whiskers" Beard presented in our *Bulletin* in 1945 seemed to frame the debate about "symbology", the practice of crafting new numerals for use in the representation of dozenal numbers, as well as "nomenclature", the names which pertain to the numerals, early on in the history of our society.

Nearly six dozen years have elapsed between our first years and this issue. Because of this we benefit from having a plethora of "symbologies", here the word applies to sets of symbols which serve as numerals, which we may observe and compare. We can put into practice what Mr. Beard was extolling, the "unbiased presentation" of our proposals, laid out side by side before all to see.

In the production of this issue, the DSA has surveyed and developed typefaces that might convey the disparate proposals across the dozens of years. In doing this, we have found a need to classify the proposals with finer resolution than Whiskers' readily discernable dichotomy of "Least Change" and "Separate Identity". *(See page 5 of this* Bulletin *for a full reprint of Mr. Beard's article).*

In the spirit of Mr. Beard's editorial, we do not intend to judge, or worse, disparage any symbology, but offer the refined classifications as an aid for your discernment of their value in your own estimation.

This article is purely concerned with so-called Western numerals, especially those of the "Anglo-American" cultural sphere, speakers of English. This article doesn't cover alterations to Eastern Arabic, Hindi, or Chinese numerals; perceivably those cultures and speakers will devise their very own symbology or nomenclature. Presented below is what this article is calling "Hindu-Arabic numeral set":

0 1 2 3 4 5 6 7 8 9

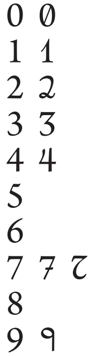

Figure 1: *Variants*

One might observe that for many of the numerals presented above, there exist variant number forms which most people would recognize. The table in Figure 1 offers a few of these. When these variants are used in society they seem to convey a regional "accent", in the case of the "Continental one" (1), to reduce confusion, as in the stroked zero (0) or seven (7). Others are merely different styles of a numeral. If a symbology designer specifies a variant as a numeral in his or her set, we will interpret that here as a departure from "Hindu Arabic", presuming there is an underlying reason for the specification.

For the sake of unity and clarity, the symbols which appear in this article have been crafted to fit the Bulletin's standard typeface, Adobe Arno Regular, as if they have perhaps already been accepted in print as numerals in use by the general public. Certain more abstract proposals are left to appear more like geometric shapes. Digits which are altered or invented by the author of a symbology are illustrated in red. Let's embark on our journey, shall we?

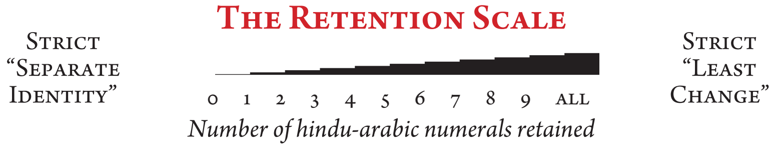

Figure 2: *The retention scale and index.*

Mr. Beard's dichotomy of "least change" and "separate identity" may be regarded as a continuous spectrum of "retention" of the existing Hindu-Arabic numerals. The above graphic illustrates the retention spectrum, with strict "separate identity" on the left wherein all existing decimal digits are discarded, and strict "least change" on the right, wherein all existing decimal digits are preserved. If we want to quantify the retention of a given symbology, we might define a "retention index" or RI, with ten (X) representing strict "least change" and zero representing strict "separate identity". The symbologies which appear below illustrate a more or less continuous spectrum of retention:

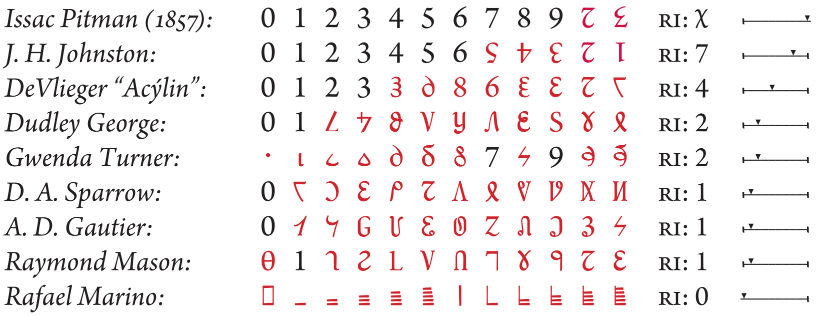
Issac Pitman (1857): RI: X
J. H. Johnston: RI: 7
DeVlieger "Acýlin": RI: 4
Dudley George: RI: 2
Gwenda Turner: RI: 2
D. A. Sparrow: RI: 1
A. D. Gautier: RI: 1
Raymond Mason: RI: 1
Rafael Marino: RI: 0

Figure 3: *A spectrum of retention of Hindu Arabic numeral forms among some dozenal symbologies.*

Between the extremes of strict "least change" and strict "separate identity", there lies a spectrum of symbologies involving partially-retained Hindu Arabic numerals, dutifully fulfilling their former roles. The most popular numeral retained among many so-called "separate identity" symbologies appears to be the zero, closely followed by the numeral one. If we count the variants of zero as "retained", the figure then seems to be retained in all but a dozen of the six dozen eleven cases studied in the "Featured Figures" spread *(See pages 13;-14;)*.

Because the number of Hindu Arabic numerals retained can be quantified discretely, we can assign a rating to each symbology to measure their position on the spectrum. This rating might be divided by the total number of numerals in the set to measure the proportion of Hindu-Arabic numerals retained in a symbology. A higher number in both cases indicates a more conservative symbology. Issac Pitman retains all Hindu Arabic numerals, thus his retention index is X, while Marino's is zero. All dozenal symbologies have a maximum retention proportion of X0 pergross; hexadecimal symbologies max out at 76 P/G; sexagesimal at 20 . Even a strict "least change" sexagesimal numeral system is, in effect, as "creative" as Zirkel's or Turner's in Figure 3 above.

⤳ *Continued on page 15;*

featured figures

Symbology Overview

from the *Duodecimal Bulletin* and Beyond

See page 19; for notes.

Style	Symbology	0	1	2	3	4	5	6	7	8	9	χ	Ɛ	Reference*
Least Change: Repurposing: Sequential														
	"IBM" (applied to dozenal)	0	1	2	3	4	5	6	7	8	9	A	B	DB 27·2·10
	Alphanumeric lowercase	0	1	2	3	4	5	6	7	8	9	a	b	
Least Change: Repurposing: Rationalized														
	D'Alambert & Buffon	0	1	2	3	4	5	6	7	8	9	X	Z	NR 02·1·11
	"Hall"	0	1	2	3	4	5	6	7	8	9	t	e	DB 2♯·1·1♯
	G. Chrystal (1150;)	0	1	2	3	4	5	6	7	8	9	τ	ε	DB 03·1·11
	Henry Parkhurst (1115;)	0	1	2	3	4	5	6	7	8	9	χ	Λ	DB 10·2·33
	"Delta-Epsilon"	0	1	2	3	4	5	6	7	8	9	δ	Ɛ	*Note 2*
	H. K. Humphrey (Strict)	0	1	2	3	4	5	6	7	8	9	d	k	DB 01·3·23
	"Alice"	0	1	2	3	4	5	6	7	8	9	Λ	Ɛ	*Note A*
	"Decker"	0	1	2	3	4	5	6	7	8	9	$\overset{1}{0}$	$\overset{1}{1}$	*Note E*
Least Change: Repurposing: Creative														
	Edna Kramer	0	1	2	3	4	5	6	7	8	9	*	#	NR 02·1·11
	Lancelot Hoghen	0	1	2	3	4	5	6	7	8	9	♀	♂	NR 02·1·12
	T. Pendlebury	0	1	2	3	4	5	6	7	8	9	?	&	NR 08·2·03
	F. S. Whellams	0	1	2	3	4	5	6	7	8	9	♯	♭	NR 09·2·09
Least Change: Derived: Aesthetically Rationalized														
	Juan C. Lobkowitz (Ɛ50;)	0	1	2	3	4	5	6	7	8	9	ᴘ	∩	NR 02·1·11
	H. G. G. Robertson	0	1	2	3	4	5	6	7	8	9	θ	ɤ	DB 03·4·07
	Tom Johnson	0	1	2	3	4	5	6	7	8	9	θ	Ħ	*Note A*
	Peter Barlow (106χ;)	0	1	2	3	4	5	6	7	8	9	φ	γ	NR 02·1·11
	Peter Barlow (106Ɛ;)	0	1	2	3	4	5	6	7	8	9	φ	π	NR 02·1·11
	Vicente Pujals de la Bastida	0	1	2	3	4	5	6	7	8	9	Շ	⊽	NR 02·1·11
	Sir Issac Pitman (10χ9;)	0	1	2	3	4	5	6	7	8	9	ε	ν	NR 02·1·11
	Sir Issac Pitman (10χ9;)	0	1	2	3	4	5	6	7	8	9	Շ	Ɛ	DB 03·2·01
	William S. Crosby	0	1	2	3	4	5	6	7	8	9	Շ	Ɛ	DB 02·2·14
	William Dwiggins	0	1	2	3	4	5	6	7	8	9	χ	Ɛ	DB 01·1·02
	G. Elbrow	0	1	2	3	4	5	6	7	8	9	χ	ε	DB 04·1·11
	T. Wood	0	1	2	3	4	5	6	7	8	9	χ	ℓ	NR 02·1·12
	DSA-"Bell" via Churchman	0	1	2	3	4	5	6	7	8	9	Ӿ	♯	DB 25·1·02
	William Schumacher	0	1	2	3	4	5	6	7	8	9	∂	ϱ	DB 37·2·19
	H. K. Humphrey	0	1	2	3	4	5	6	7	8	9	∂	ƙ	DB 01·3·23
	Paul Van Buskirk	0	1	2	3	4	5	6	7	8	9	ɖ	ɇ	DB 03·4·18
	Ray Greaves / David James	0	1	2	3	4	5	6	7	8	9	Ɐ	Γ	*Note C*
	Ray Greaves	0	1	2	3	4	5	6	7	8	9	Ⴙ	Γ	*Note C*
	De Vlieger "Arqam" (1193;)	0	1	2	3	4	5	6	7	8	9	Շ	Γ	DB 45·2·1♯
Least Change: Derived: Technically Rationalized														
	Don Hammond	0	1	2	3	4	5	6	7	8	9	ᒧ	ᒪ	*Note B*
	Don Hammond	0	1	2	3	4	5	6	7	8	9	ᘔ	Ɛ	*Note B*
	Niles Whitten 1	0	1	2	3	4	5	6	7	8	9	ᘔ	ε	*Note 5*
	Niles Whitten 2	0	1	2	3	4	5	6	7	8	9	ᘔ	Ł	*Note 5*
	Paul Rapoport	0	1	2	3	4	5	6	7	8	9	Ƨ	L	DB 31·3·04
	"Bell" numerals via Zirkel	0	1	2	3	4	5	6	7	8	9	H	E	DB 32·1·12
	"Bell" via Radio Shack	0	1	2	3	4	5	6	7	8	9	⊢	ᗺ	DB 32·1·12
Least Change: Improvisation: Rationalized														
	Charles Bagley 2	0	1	2	3	4	5	6	7	8	9	ρ	ɿ	DB 1Ɛ·2·37
	Tom Linton	0	1	2	3	4	5	6	7	8	9	Ɔ	ɿ	DB 1Ɛ·2·37
Least Change: Improvisation: Creative														
	Handy/Norland	0	1	2	3	4	5	6	7	8	9	Ɛ	∠	DB 01·2·22
	Jean Essig	0	1	2	3	4	5	6	7	8	9	Շ	∠	DB 10·2·48
	Charles Bagley 1	0	1	2	3	4	5	6	7	8	9	Ɉ	ℓ	DB 11·2·48

Style *Symbology*	0	1	2	3	4	5	6	7	8	9	χ	Ɛ	*Reference**
						Dozenal Digit							
"Compromise"	0	1	2	3	4	5	6	7	8	9	χ	∠	DB 1Ɛ·1·15
Frank Plevin	0	1	2	3	4	5	6	7	8	9	ᵷ	ᖇ	NR 06·2·07
Dr. Paul Rapoport	0	1	2	3	4	5	6	7	8	9	ɤ	Ϗ	DB 2Ӿ·2·24
Shaun Ferguson 2	0	1	2	3	4	5	6	7	8	9	Ћ	Ғ	*Note J*
Separate Identity: Repurposing: Sequential													
"Ernest Stryver"	a	b	c	d	f	g	h	i	l	m	n	o	DB 01·3·22
J. Halcro Johnson-1	0	1	2	3	4	5	6	5̄	4̄	3̄	2̄	1̄	DB 06·2·25
Louis Loynes 1	Z	I	A	B	C	D	E	F	G	H	J	K	NR 03·2·03
Louis Loynes 2	M	A	B	C	D	E	F	G	H	J	K	L	NR 03·2·03
Separate Identity: Repurposing / Derived: Rationalized: Modular Symmetry													
Dᵉ Vlieger "Acylin" (11χƐ;)	0	1	2	3	Ʒ	∂	8	6	ɛ	Ɛ	ᘔ	ᒥ	*Note E*
J. Halcro Johnson-2	0	1	2	3	4	5	6	Ϛ	ŧ	Ɛ	ᘔ	I	DB 02·1·18
Separate Identity: Improvised: Rationalized: Additive Analog													
Rafael Marino	▯	_	=	≡	≣	≣	|	∟	∟	∟	∟	∟	DB 38·2·10
F. Ruston	0	/	Λ	Π	⋜	Χ	ρ	∠	λ	ℿ	⋜	Χ	NR 03·2·03
Gwenda Turner	·	ı	ɩ	∆	∂	δ	8	7	ϟ	9	ə	∂	DJ 04·04
R. J. Hinton	0	ρ	ϐ	Ɛ	6	8	∞	ɤ	ɣ	ɣ	ϕ	ℋ	NR 03·2·07
P. D. Thomas "Modular"	Ø	⅃	ϟ	Ψ	ǂ	λ	⋇	¥	‡	Ʊ	∠	⊧	*Note D*
D. A. Sparrow	0	ᒣ	Ɔ	Ɛ	ρ	ᘔ	Λ	ᴕ	Ʋ	Ɒ	Ӿ	И	NR 03·2·0Ɛ
Fred Newhall "Efficient"	↝	⌒	⌣	⌓	♉	↝	⋀	⌒	⌣	⩗	⩗	∿	DB 2Ӿ·3·16
Separate Identity: Improvised: Rationalized: Multiplicative / Exponential													
Shaun Ferguson 1	Ø	ȷ	ħ	ℜ	ɓ	₽	≀	ʎ	ɱ	Ʊ	Ғ	Ξ	*Note C*
Separate Identity: Improvised: Rationalized: Rotational Run Sequence													
Lauritzen "Gravity" (11χ0;)	⦶	⊘	⊖	⌽	⊖	⊘	⍥	⍤	⍜	⍦	⍊	⊝	DB 3♯·1·04, L
Kingsland Camp [1]	ɸ	∠	ⱡ	θ	∂	ᒣ	φ	7	ɓ	θ	ϕ	⦣	DB 02·1·16
Separate Identity: Improvised: Rationalized: Indexed Value													
Smooth Binary Coded	0	1	ſ	∩	L	⅃	⊦	h	J	⊣	ƨ	d	
George P. Jelliss	1	⊦	L	F	[	E	‖	H	U	A	0	8	*Note F*
Separate Identity: Improvised: Modular Symmetry													
A. D. Gautier (10χχ;)	0	1	Ꮑ	G	Ʊ	Ɛ	0	Z	ᗢ	Ɔ	3	ϟ	NR 03·2·03
George Brost "Dyhexal"	⅂	↓	┘	]	˥	↿	┌	↾	┌	[	L	⇂	DB 35·2·0Ӿ
James Conlon	▽	∠	⊾	◁	⊦	⋖	△	7	⊣	▷	⌟	⦣	*Note A*
Separate Identity: Improvised: Creative													
Dudley George (±1146;)	0	1	∠	ƺ	ϑ	V	ʮ	Λ	Ɛ	S	ɤ	Ϙ	DB 02·2·17
A. Chilton	0	/	Z	3	∠	⅄	∡	7	Χ	ƴ	И	⋜	NR 02·1·10
Shaun Ferguson	0	1	₸	ℜ	ɓ	ʔ	4	ʎ	И	V	Ξ	Ɛ	NR 02·1·10
Louis Loynes 3	▷	1	2	3	ℵ	И	6	7	ɤ	9	ᘔ	Ɛ	*Note A*
Mohan Kala	⧄	⊥	Z	⋾	⊠	⊻	⟥	⋌	⊟	∠	⋊	∑	DJ 31·35
Raymond Mason	θ	1	ʅ	ƻ	L	V	∩	˥	ɤ	ɋ	ᘔ	Ɛ	*Note A*

Symbology	0	1	2	3	4	5	6	7	8	9	χ	Ɛ	10	11	12	13	*Reference**
							Hexadecimal Digit										
Least Change: Repurposing: Sequential																	
"IBM"	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	DB 27·2·10
Least Change: Derived: Rationalized																	
Whillock Com.	0	1	2	3	4	5	6	7	8	9	Χ	∠	ᘔ	Ɛ	ƺ	Ϛ	DB 27·3·07
Least Change: Repurposing: Creative																	
"WordPerfect"	0	1	2	3	4	5	6	7	8	9	/	\	:	*	?	+	DB 33·2·1Ӿ
Least Change: Improvised: Creative																	
"Arqam" (1193;)	0	1	2	3	4	5	6	7	8	9	ᘔ	ᒣ	ɤ	∂	Ɛ	℘	DB 45·2·1♯
Separate Identity: Improvised: Rationalized: Indexed Value																	
Bruce Martin	0	┘	┤	╡	┤	╡	╡	≡	┐	]	┐	]	┐	]	]	]	*Note M*
Schumacher	0	¬	r	∩	L	ㄣ	⊢	h	┘	┤	┘	┤	∪	4	⊬	H	DB 33·3·0Ӿ
Binary Coded	0	ƛ	ɍ	ɲ	ɏ	ㄣ	⊢	h	⅃	┤	┘	┤	ɏ	4	⊬	H	DB 49·1·15
T. Hauptman	8	φ	9	ƨ	ɸ	|	ƅ	ɖ	∂	ʔ	3	2	6	ς	S	Ɛ	*Note T*
Separate Identity: Repurposing: Rationalized: Indexed Value																	
Whillock Com.	0	1	2	3	4	5	6	7	8	9	Ȟ	Ƅ	ɗ	E	h	Ƽ	DB 27·3·07

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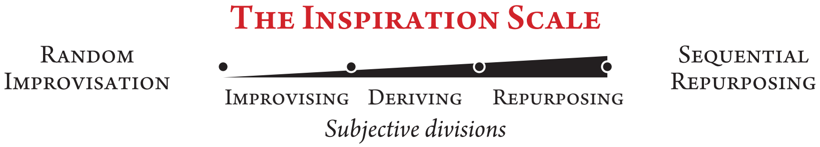


Figure 4: *The inspiration scale, related to the source of inspiration for new numerals.*

Retention represents a key consideration in the development of a new set of numerals. Another consideration regards the source of inspiration for any new numerals. One may draw from other sets of symbols in the public lexicon, such as from alphabets or musical notation, and append the set in sequence where seen fit. This "sequential repurposing" represents a more conservative extreme. New symbols are added, but they are somehow familiar and in sequence. One might also devise new symbols entirely randomly and ascribe a meaning to them, "random improvisation", representing the other extreme. This scale is more complex than the retention scale; let's examine examples.

REPURPOSING. The first set of strategies involves using existing symbol sets, such as the Latin, Greek, or other alphabets, the symbols of the planets or zodiac, etc., to extend the Hindu-Arabic numerals. Repurposing is typically the province of least-change or more retentive symbologies.

Sequential repurposing involves simply appending a more or less contiguous series of symbols to the existing numerals to attain the requisite number of digits to convey the base. The following is a common hexadecimal example:

0 1 2 3 4 5 6 7 8 9 A B C D E F

J. Halcro Johnson's reverse notation, appearing in Vol. 6 № 2 page 25;, extracts the numeral sequence 0 through 5 of the Hindu-Arabic numeral set, echoing it backward. For structural reasons, i.e., in order to represent "balanced" dozenal notation, the reverse notation can be seen as redefining the latter portion of the dozenal numeral set, here denoted as "Johnson-1" as follows:

$0\ 1\ 2\ 3\ 4\ 5\ 6\ \bar{5}\ \bar{4}\ \bar{3}\ \bar{2}\ \bar{1}$

This can be seen as reincorporating the symbols 1 through 5 and mildly modifying them with a diacritical bar to distinguish these negative numbers from their positive cousins, as they march in reverse from 0. Alternatively, the set can be regarded as including seven Hindu-Arabic symbols 0 through 6, and a diacritical bar that is placed above a digit to represent negativity.

Selective repurposing involves choosing some symbols from an existing foreign set and reprogramming them in a significantly interrupted sequence or in a sequence which has no relation to the original foreign sequence. "Ernest Stryver" submitted a tongue-in-cheek letter in Vol. 1 № 3 page 22; which repurposes the letters of the alphabet (with some exceptions) to serve as dozenal digits. This would be a less-pure manifestation of a sequentially repurposed Separate Identity symbology: perhaps it is a selectively repurposed set.

a b c d f g h i l m n o

Symbols can be chosen which are related to the names of the digits, whether these names be the English decimal names, or other names. Symbols from existing sets may be selected for their aesthetics; perhaps these convey some aspect of the integer they represent. DSA Past President Harry Robert proposed the following extension in Vol. 2 № 1 page 1χ;. Perceivably his scheme uses the Greek initials of the words "dek" or "δεκα", standing for digit ten and "el" or "ενδεκα" for eleven[2].

0 1 2 3 4 5 6 7 8 9 δ Ɛ

H. K. Humphrey set out the following symbology, suitable for the typewriter, in Vol. 1 № 3 page 23;. The lowercase "k" as el or "kel", filled the entire line height, unlike "e", eliminated the need to shift, and is positioned next to the lowercase "l", which in the day was used as a numeral "1".

0 1 2 3 4 5 6 7 8 9 d k

Creative/aesthetic repurposing, finally, encompasses the use of symbols from existing sets which may be chosen for no particular or identifiable reason. Edna Kramer borrowed two "punctuation" marks available on typewriters to serve as digit-ten and digit-eleven in the 1951 book *The Main Stream of Mathematics*.[3] These same characters became the so-called "Bell" numerals, which were introduced in meeting minutes from 1973 in in Vol. 25 № 1 page 1, initially began as the now-familiar "star" and "pound" we use rather universally today on telephone keypads.

0 1 2 3 4 5 6 7 8 9 * #

Derivation. Symbols selected from existing symbol sets can be altered to adjust for any combination of perceived constraints. The author of new numerals can use an existing "antecedent" symbol as a starting point, making minor alterations to suit the intent.

Visual harmony and appearance is a chief constraint for some authors, who try to produce transdecimal digits which "blend in" or resemble the existing Hindu-Arabic numeral set. Sir Issac Pitman proposed a classic "aesthetically derived Least Change" set of transdecimal symbols in 1857, mentioned at length in Vol. 3 № 2 page 1, where he writes that he adds a "'T' modified to '↊' for ten, and 'E' altered to 'Ɛ' for eleven".

0 1 2 3 4 5 6 7 8 9 ↊ Ɛ

Our own numerals, devised by William Addison Dwiggins, are likewise aesthetically rationalized derivations of letters. The χ is described by many former issues of the *Bulletin* as inspired by the Roman numeral X, standing for decimal ten. The Ɛ is described in Vol. 1Ɛ; № 2 page 44; as a "fancy form of the italic *E* known to printers as 'swash E'".:

0 1 2 3 4 5 6 7 8 9 χ Ɛ

The "Bell" numeral forms which now appear in the *Duodecimal Bulletin* are slightly altered to resemble Roman X with a single cross bar through it to represent "*not*-ten", and the number 11 with two cross bars through it to represent "*not*-eleven". This set can be considered a derivation of the "strict" Kramer/Bell numerals which appeared under creative repurposing.

0 1 2 3 4 5 6 7 8 9 𝒳 ♯

H. K. Humphrey, author of an above-mentioned symbology, seemed inclined to make the "d" more graceful. His compatriot in symbology, John Jarndyce (a pen name used by H. C. Churchman), writes in VOL. 24; page 15; that the Humphrey symbology may persist letter-like initially, "until someone attempts to pretty them up", thus:

0 1 2 3 4 5 6 7 8 9 ∂ ƙ

A common constraint since the advent of "digital" readouts in the mid twentieth century is legible expression of a digit using 7 or 13 segment LCD/LED readouts. Don Hammond presented a set of numerals which altered Sir Issac Pitman's 1857 transdecimals in the interest of making these more amenable to 7 or 13 segment LCD/LED readouts[4]. Hammond attempted to make the handwritten version of his numerals more amenable to these readouts. Niles Whitten further enhances Hammond's pull towards the readout constraints, in two waves[5]:

Pitman (1857): 0 1 2 3 4 5 6 7 8 9 ↊ ↋
7-segment: 0 1 2 3 4 5 6 7 8 9 d ⱡ
Hammond: 0 1 2 3 4 5 6 7 8 9 ↊ ↋
Whitten-1: 0 1 2 3 4 5 6 7 8 9 ↊ ɛ
Whitten-2: 0 1 2 3 4 5 6 7 8 9 ↊ ⱡ

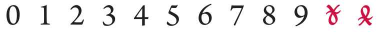
IMPROVISATION. New numerals can be invented in complex, subjective, or random ways. The rationally improvised low-retention symbologies exhibit a wide array of organization which will be the subject of an article in the next issue which explores the tools by which one can produce one's own symbology. We'll examine some of the simpler symbologies here.

Rationalized improvisation. An author of a symbology may have specific reasons for inventing wholly new symbols for transdecimal digits. The reasons can include attempts to convey some aspect of the integer, its English decimal name, or handwriting efficiency.

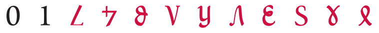
The example below, presented in the article "New Symbols", VOL. 15; № 2 page 34; by Charles Bagley, follows a brief exploration of symbol forms, in an attempt to create "two new symbols that can stand erect with our ten basic numbers and lend them dignity." This is closely followed by Tom Linton's set. Both sets are examples of rationalized, improvised Least Change symbologies.

Bagley-2: 0 1 2 3 4 5 6 7 8 9 ρ ɾ
Linton: 0 1 2 3 4 5 6 7 8 9 Ɔ ɾ

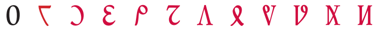
Creative improvisation. Some authors may find satisfaction with a symbol they simply invented, or which evolved through exercise over a period of time. Dr. Paul Rapoport's symbology, presented in VOL. 2𝒳; № 2 page 24; in summer 1985, exemplifies an arbitrarily improvised Least Change set. He states, "I decided that I had to create symbols for ten and eleven which would not look like any other numerals or commonly used symbols, nor like any letters of the alphabet". The resultant forms of the numerals, which ended up symmetrical and similar to one another, but distinctive, appear to be completely improvised:



Dudley George's personal symbology, dating from the mid twenties, appears in one of the first Bulletins, Vol. 2 № 2 page 17;. These come complete with a Separate Identity nomenclature (set of number names):



A "creative" system need not stand without order or design. At times there are multiple directives at work which impart forms on numerals which perhaps end up making the underlying systems of order less clear. D. A. Sparrow expressed "A Suggested Series of Notation and Names" in the *Dozenal Newscast*, Year 2, № 1, page Ɛ;. In his article he explains how he constructs each digit, careful not to produce a new numeral that can be confused with the existing corresponding decimal numeral. He explains, "One has been a straight line for a long time; but this must be changed as .1 would no longer by (sic) the same quantity, that is it will change from [one tenth] to [one twelfth]". For 2 and 3, he continues "Two would be points joined together … Ɔ" and "As a line is not possible, we must have three points joined, and in order to distinguish it from 3, put backward … Ɛ". Thus, Sparrow is attempting to logically produce a system of numerals, the basic sequence {1, 2, 3} constructed by joining points, for instance, but then overlays the need to distinguish these from Hindu Arabic or Roman numerals:



In addition to Ralph Beard's readily-discernable scale of retention of the Hindu Arabic numerals, we can further classify the symbologies according to their source of inspiration for new numerals.

In the next issue, we will explore a set of strategies one can use to produce new numerals. These strategies tend to produce the most vivid "separate identity" symbologies. We'll also visit the DozensOnline forum for some ideas regarding criteria that should be taken into account when devising symbologies.

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[1] See the original K. Camp and D. George proposals as shown on page 14; the *Duodecimal Newscast*, Year 3, № 2, p. 3, 1165; (1961.) seems to feature a few transcription errors.

[2] Though Harry Robert suggested lowercase delta (δ) to represent digit-ten in "Ideas & Opinions", Vol. 2 № 2 page 1X;, it's unclear whether this is his invention or something inherited from others. The insertion of the epsilon (ε), though not directly specified in Mr. Robert's letter, is supported by at least two others. Mr. John Selfridge penned a letter in Vol. 3 № 3 page 24; supporting delta and epsilon, as well as the practical alternative of "d" and "e" in their stead on typewriters. Mr. George P. Jelliss wrote in Vol. 36 № 2 page 14; supporting delta and epsilon in resonance with these earlier suggestions. Additionally, Mr. Jelliss saw epsilon's shape resonant with the "Ɛ" used by the Dozenal Societies.

[3] "New Duodecimal Notations", *Duodecimal Newscast*, Year 2, № 1, page 11;.

[4] Retrievable at time of publishing at www.dozenalsociety.org.uk/basicstuff/hammond.htm, part of the official website of the Dozenal Society of Great Britain.

[5] Retrieved in early 2010 at http://www.angelfire.com/whittenwords/measure/dozchar.htm, Mr. Niles Whitten's personal website.

the mailbag

Mr. H. K. Baumeister, a Life Member, № 140;, writes:

»Dear Sirs: The following is a teaser that you may find of interest.

Over half a century (How is that idea expressed dozenally?) ago when I started work at my first full time employment at IBM, I was chagrined to think my job did not involve four good wheels and an internal combustion engine. The Research/Development group I was with were developing a personal automatic calculator (PAC) near Columbia University that had a cathode ray tube (CRT) visual output display that easily could be seen from the operating console, a keyboard on a laboratory table, halfway across the small room. They were using the following result of a keyed-in problem to check their calculators first thing in the morning:

12,345,679. × 999,999,999. = ?

While reading your recent *Bulletin* Vol. 4Χ; № 1, especially pp. 9;—Ɛ;, & 25; it occurred to me that some of your readers might be briefly entertained working out both the decimal result, ?., above and the duodecimal result, ?;, below if the machine had been duodecimal:

1,234,567,89E; × EE,EEE,EEE,EEE; = ?

(where E above represents Ɛ; or "el")

Sincerely, H. K. Baumeister, DSA Life Member, № 140; ::::

* * *

Notes from "Featured Figures", pages 13; and 14;:

* The reference notation indicates items in the DSA's *Duodecimal Bulletin* (DB) or the DSGB's *Duodecimal Newscast, Duodecimal / Dozenal Review* (NR) in the format Volume·Number·Page. Items deriving from the DSGB's *Dozenal Journal* (DJ) are presented in the format Continuation Number·Page. All figures in the dozenal symbology in use at the time of publication of that issue. Thus, DB 02·1·1Χ refers to Vol. 2 № 1 page one dozen ten; DB 2#·1·1# refers to Volume two-dozen eleven № 1 page one dozen eleven. The publications of the DSGB use the Pitman symbology.

A Items retrievable at time of publishing from the Dozenal Society of Great Britain's official website, specifically, http://www.dozenalsociety.org.uk/basicstuff/digits.htm.

B Retrievable at time of publishing at http://www.dozenalsociety.org.uk/basicstuff/hammond.htm, part of the official website of the Dozenal Society of Great Britain.

C Private communication with the authors.

D P. D. Thomas, (1987). *Modular Counting: A Preview of the Numbers of the 21st Century* (Revised Edition). Clarence Gardens, South Australia. Modular Conversion Bureau.

E These systems are introduced here by the author as examples of his system in the case of "acýlin", and as a plausible example in the case of "Decker".

F Retrievable from the DozensOnline internet forum. George P. Jelliss (2005). Symbols for TEN and ELEVEN? (Internet forum thread in the "On Topic" Forum, "Number Bases" topic) http://z13.invisionfree.com/DozensOnline/index.php?showtopic=11, entry by user "GPJ" at 10:54 am 14 August 2005.

J Retrievable from the DozensOnline internet forum. Shaun Ferguson (2009). Symbols for TEN and ELEVEN? (Internet forum thread in the "On Topic" Forum, "Number Bases" topic) http://z13.invisionfree.com/DozensOnline/index.php?showtopic=11, entry by user "Shaun" at 8:41 am 8 June 2009.

L "Nature's Numbers" or "gravity-generated numbers", retrievable at http://www.earth360.com/math-naturesnumbers.html, Prof. Lauritzen's website.

M *Letters to the editor: On binary notation*, Bruce A. Martin, Associated Universities Inc., Communications of the ACM, Volume 11, Issue 10 (October 1968) Page: 658.

T Retrieved at Traveler Hauptman's wiki at http://www.hauptmech.com/base42/wiki/index.php?title=Main_Page; confirmed through private communication with the author.