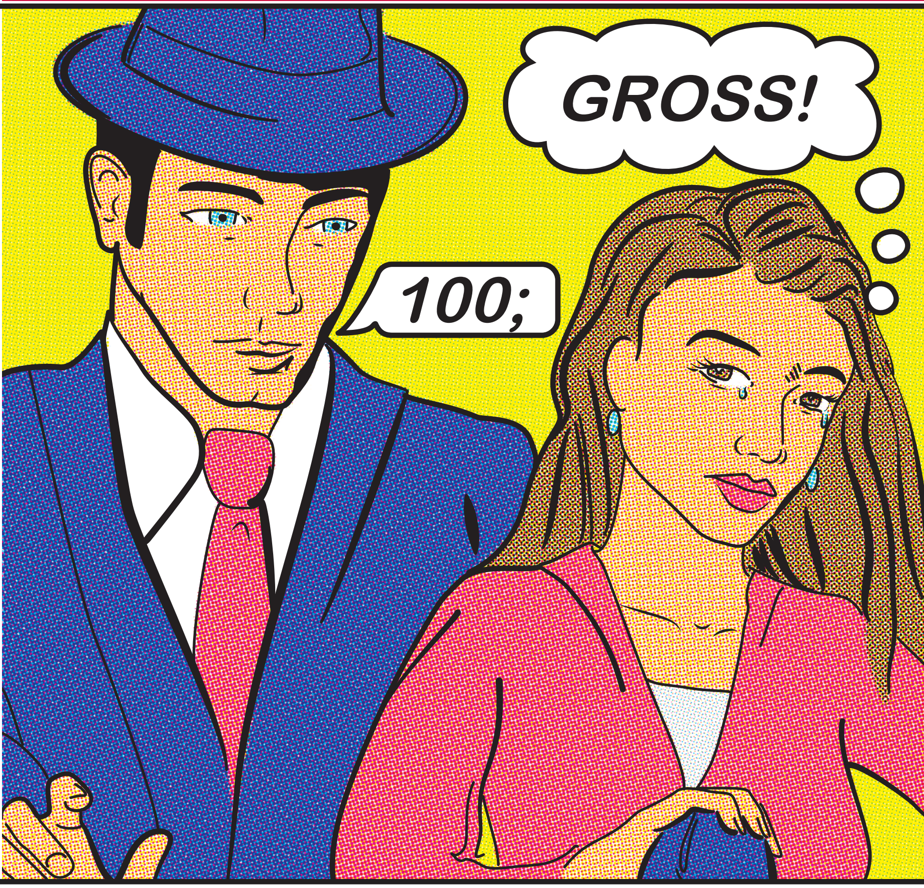
THE Duodecimal Bulletin
Vol. 51; № 1; Year 11Ɛ9;

The Duodecimal Bulletin ▪ Volume 51; (61.) ▪ Number 1; ▪ Whole Number X1; (121.)



The Nomenclature Issue:

Systematic Dozenal Notation

page 9

Whole Number
X1;

ISSN 0046-0826

The Dozenal Society of America

is a voluntary nonprofit educational corporation, organized for the conduct of research and education of the public in the use of base twelve in calculations, mathematics, weights and measures, and other branches of pure and applied science

Basic Membership is free, Supporting Membership dues are $12 (USD) for one calendar year. You can always donate using PayPal at www.dozenal.org/drupal/content/donate.

The *Duodecimal Bulletin* is an official publication of
The Dozenal Society of America, Inc.
5106 Hampton Avenue, Suite 205
Saint Louis, MO 63109-3115

Editorial Office

Michael T. De Vlieger, Editor
5106 Hampton Avenue, Suite 205
Saint Louis, MO 63109-3115
(314) 351-7456 Editor@Dozenal.org

Official Website:
www.Dozenal.org

Email us at:
Contact@Dozenal.org

The Dozenal Society of Great Britain:
www.Dozenalsociety.org.uk

The *Duodecimal Bulletin* Volume Five Dozen One, Number One

Volume five dozen one (61.) • № 1 • Whole Number ten dozen one (121.)

THE Duodecimal Bulletin

Contents

The page numbers appear in the format Volume·Number·Page

Welcome New Members!

The Dozenal Society of America welcomes the following New Members! Subscribers' Member numbers appear in red, with names in bold. Thank you and welcome!

3Χ9; Jose A. Reyes, 3ΧΧ; Catherine L. Goodman, 3ΧƐ; Kevin P. Gardner, 3Ɛ0; **John D. Hansen**, 3Ɛ1; Christopher C. Eldridge, 3Ɛ2; Ben Moran, 3Ɛ3; **Derik J. Kauffman**, 3Ɛ4; Avraham Gindi, 3Ɛ5; Daniel J. Turner, 3Ɛ6; Joshua C. Greene, 3Ɛ7; **Robert W. Maxfield**, 3Ɛ8; Chiara L. M. Watson, 3Ɛ9; Vincenzo E. Sicurella, 3ƐΧ; Adam C. Fuehrer, 3ƐƐ; **Wendy Y. Krieger**, 400; Don Miller, 401; **Anastasiya V. James**, 402; Chris Edwards, 403; Daniel I. Beard, 404; Americans for Customary Weight & Measure, 405; Nick Reymann, 406; Charles Exner, 407; **Blake VanWinkle**, 408; Mark Thomas, 409; Christian Poerksen, 40Χ; Pankaj Godbole, 40Ɛ; Ryan Gourley, 410; Bryce K. Crawford, 411; Imre Ipolyi, 412; **Robert Hovden**, 413; Dehim Verveen, 414; Michael A. Gyurgyak.

president's message

During this five dozen ninth year of the Dozenal Society of America, I, having recently taken up its Presidency, have had the opportunity to reflect on our history and our current mission. Stepping into the shoes of the likes of Andrews, Beard, Zirkel, and my many other predecessors can hardly prompt me otherwise.

For nearly six dozen years the DSA has persevered in promoting base twelve counting, arithmetic, and metrology, despite every prediction that it would inevitably fail, struck down by the merciless march of decimalized progress.

Indeed, more than merely persevering, we have prospered, grown, and deepened our exploration of the boundless depths of the dozen. The members of the DSA are rightly proud of what the Society has done throughout its storied past.

The rise of the Information Age over the last two dozen years has presented new difficulties, and as we approach the year 1200; (2016.), those difficulties will only increase. We were late coming into the digital age, and have been slow to embrace it even then. But we have begun to meet these challenges, too; and in the coming years, we will make this new age our own.

But we must not mistake the rush of technological progress for the invalidation of past hopes and success. On the contrary, I see my job as your president as preserving the accomplishments of the past while enabling those of the future; and hopefully, we in the present may yet eke out a few accomplishments of our own.

So please, give your input and your efforts to the DSA; they have never been wasted in the past, and I will do everything I can to ensure that they will not be wasted in the future.

Welcome, Newscast!

The first issue of the *DSA Newscast* was sent electronically to its Members in mid March 11Ɛ9;. The name is a nod to the publication of our British brethren at the Dozenal Society of Great Britain, who published their flagship journal *The Duodecimal Newscast* from 1173; to 117Ϫ; (1959–1966.), before they began publishing a more formal journal.

Our purpose is similarly simple: to provide a more regular and more down-to-earth publication for the world of dozenals than is currently available. The *Newscast* is *not* intended as a substitute or replacement for the *Duodecimal Bulletin*; the purposes of the two publications are quite different. As explained in our namesake's first issue by Brian Bishop:

> "Until we can start a regular magazine I shall keep members informed of activities in the world of duodecimals by means of such circular letters as this. I should also like members to use it to air their views."

This little electronic newsletter is for minor things, things too small or brief or inconsequential for the *Bulletin*; or, conversely, things too time-sensitive or urgent to wait for the next *Bulletin*. It's perfectly suited for announcing dozenal-related meetings, speeches, discussions, curiosities, or any item of interest you, the Member, desire to share with other dozenalists.

THE NOMENCLATURE ISSUE

This issue of the *Duodecimal Bulletin* focuses on the words we use to name duodecimal numbers. This is not a comprehensive survey of all the nomenclature proposals as the symbology issues were. Instead, we look at a conservative system that might help us explain how dozenal math works to Joe Sixpack, and a comprehensive new system that helps dodekaphiles name every number they can think of. The third article in the suite takes a look at systematizing the names of bases. I hope you enjoy this Nomenclature issue of the *Duodecimal Bulletin*!

—*Þe Editor*

NYC: Second St. Subway sign

What we call our numbers really has an effect on how we use them. It is an important question.

First St. sign, Hermann, MO

Symbology & Nomenclature

The DSA does NOT endorse any particular symbols for the digits ten and eleven. For uniformity in publications we use Dwiggins dek (Ӿ) for ten and his el (Ɛ) for eleven. Whatever symbols are used, the numbers commonly called "ten", "eleven" and "twelve" are pronounced "dek", "el" and "dough" in the duodecimal system.

When it is not clear from the context whether a numeral is decimal or dozenal, we use a period as a unit point for base ten and a semicolon, or Humphrey point, as a unit point for base twelve. Thus ½ = 0;6 = 0.5, 2⅔ = 2;8 = 2.66666..., 6⅜ = 6;46 = 6.375

Dozens in Plain English

by Michael De Vlieger

The wonderful thing about the English language is its ability to pick up foreign words or invent neologisms, and have these flow into diction rather organically. New words like "selfie," "wifi," and borrowed ones like "barista", "avatar" eventually course through our conversations and meld into our language. What enables that is broad public application or common usage in a subculture that manages to enter popular culture.

We dozenalists don't yet enjoy mainstream status, even if we did, we don't have a standard system of dozenal nomenclature in place that could wend its way into common parlance. There are proposals that some use and some don't. Fortunately, the English language comes equipped with simple duodecimal nomenclature.

Decimal positional notation.

Before we delve into how we might use "plain English" to denote duodecimal numbers, let's review how we describe decimal numbers in English. Aside from the names of numerals, both cardinal (one, two, etc.) and ordinal (first, second, etc.), we have names of ranks or positions. In decimal positional notation, looking at Table 1 and proceeding from right to left, we have units, tens, hundreds, thousands, etc. We can go on further to ten thousands, hundred thousands, etc. Each place represents a power of ten, again from right to left 10^0, 10^1, 10^2, 10^3… Thus in the example, two to the thirteenth power, or the decimal number 8,192, we have eight thousand one hundred ninety two.

Duodecimal positional notation.

The words "dozen" and "gross" convey the numbers twelve and 144 respectively. The former term is used often in commerce to precisely specify groups of twelve. Media use the term "dozens" to signify an approximate multitude ranging between twenty and a hundred, as in the phrase "dozens were involved." The latter term is less common outside of shipping and supply management, but still conveys an exact group of a dozen dozens. Used as these are commercially, the terms "dozen" and "gross" are perfectly suited to describe simple duodecimal arithmetic.

The names of dozenal numerals can retain their English names, from zero to nine, ten, and eleven. When we reach what we call twelve, we would use "one dozen" instead, then continue to one dozen one, one dozen two, …, one dozen eleven, two dozen, etc. Counting to a gross is fairly easy and easily understood just by using words we already have in English.

In dozenal positional notation, each position represents a power of the dozen. Referring to Table 2 and proceeding right to left, we have 12^0, 12^1, 12^2, 12^3… (expressed here and in the table in decimal figures). The positions have names as in decimal: units, dozens, grosses, great grosses, etc. We can proceed further, though the English language does not furnish standard names for powers of the dozen greater than 12^3. Here we furnish a new term "grand grosses" for 12^6 to complete the illustration. Thus, the same number, two to the one dozen first power, is 'four great gross eight gross ten dozen eight' in dozenal. Alternatively, one might say 'four dozen eight gross ten dozen eight.'

Plain English dozenal nomenclature facilitates explaining the system to friends not into math, or helping those new to dozenal get accustomed to its arithmetic. Let's try it!

MILLIONS	HUNDRED THOUSANDS	TEN THOUSANDS	THOUSANDS	HUNDREDS	TENS	UNITS
10^6	10^5	10^4	10^3	10^2	10^1	10^0
0 ,	0	0	8 ,	1	9	2 .

Table 1. The English words for decimal positional notation

"GRAND GROSSES"	GROSS GREAT-GROSSES	DOZEN GREAT-GROSSES	GREAT-GROSSES	GROSSES	DOZENS	UNITS
12^6	12^5	12^4	12^3	12^2	12^1	12^0
0 ,	0	0	4 ,	8	Χ	8 ;

Table 2. Dozenal positional notation in an extended form of "plain English"

We could read the problem Χ + Ɛ = 19; as "Ten plus eleven is one dozen nine." We can use this as a bridge to dozenal arithmetic by saying "ten plus eleven is twenty one, which is one dozen nine." Eventually we can leave out the decimal equivalent entirely to compute solely in dozenal. Similarly, 5 × 9 = 39; "five times nine is three dozen nine," which is thirty-six plus nine, making forty five. From these examples, it's clear that any introduction to dozenal arithmetic doesn't need to resort to novel nomenclature. We don't need to bring out the toolchest of "alien" sounding names that color the subject 'far out' to most people, when we talk about "dek do el" or "elfzen four." Ten dozen eleven and eleven dozen four are completely adequate to handle those concepts.

We can go on to larger numbers and still enjoy understanding, even if one might not be able to picture the quantities involved. The slightly more complicated problem Χ × 84 = 6Ɛ4; is "ten times eight dozen four is six gross eleven dozen four." This inability to picture the quantity probably comes from the receiver's unfamiliarity with multiples of 144 more than it does the usage of the terms "gross" and "dozen." The term "gross" is a lot less common in everyday speech so it might confuse some receivers, especially if they are young.

When we begin to involve numbers in the great grosses, we appear to be building towers made out of words we don't commonly hear, even though they are perfectly normal English words. The year 2013 dozenally is one great gross one gross eleven dozen nine, or alternatively one dozen one gross eleven dozen nine.

Eventually, we can't continue using a system whose growth was stunted perhaps by the acceptance and usage of a "purely decimal" hundred (surpassing the use of "long hundred" of 120 units). We will need to innovate the extension to handle the dozenal analogy of decimal millions and billions. We might try to use the terms that already exist, e.g., "grand gross" for twelve to the sixth power, but it isn't standard. We've already left "plain English" behind.

This implies eventually, some novel duodecimal nomenclature will be necessary. We haven't even addressed the names of the negative dozenal powers, which have no keen English set of names. To move beyond the simplest dozenal arithmetic, as the character Brody said in the movie *Jaws* back in 'eight dozen seven, "You're gonna need a bigger boat."

This article borrows some material from Prof. Jay Schiffman's "Fundamental Operations in the Duodecimal System", originally published in *Bulletin* Vol. 31; №. 3, remastered and retrievable at http://www.dozenal.org/drupal/sites/default/files/db31315_0.pdf.

Closing Time

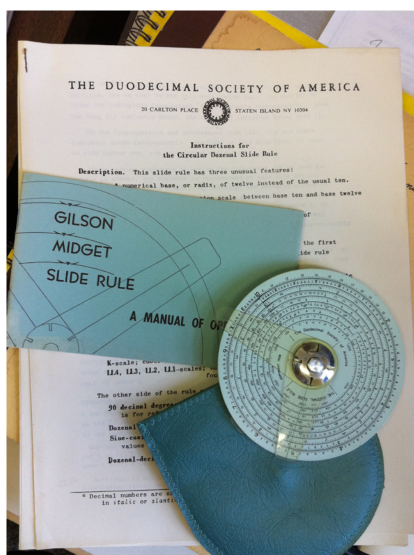
On 19 March 1988, the Dozenal Society of America passed a resolution declaring a collection of materials at Nassau Community College be dedicated to founder F. Emerson Andrews. Ms. Edith Andrews was present for the convocation and placement of a plaque. You can read about it at *Bulletin* Vol. 31; №. 2, pp 14–15;. The most important parts of the trove of dozenal material that flowed into the possession of the Society were placed in the care of the College library.

On 25 June 2011, the Dozenal Society of America had its last regular Annual Meeting at the Commons building at Nassau Community College. We'd been based there since the seventies, as many faculty on Long Island were involved in the organization. The Society's steadiest years were commanded from the College, with Prof. Zirkel, Dr. Zirkel, Prof. Schiffman at the helm. The College requested the room be turned over to accommodate student leadership activities.

Members Brian Ditter, Jay Schiffman, Gene & Pat Zirkel, Jen Seron, Dan Simon, and Michael De Vlieger were on hand to vacate the DSA office. All present had their fill of whatever material was left. A copy of each *Bulletin*, *Newscast*, and whatever range of materials was saved to be digitally preserved and maintained at two remote sites. One site is in St. Louis while the other rests with current President Don Goodman III. The most important of the Society's files, pertaining to many long-standing past Members, resides with Mr. De Vlieger in St. Louis. These include some of their handwritten notes.

The work of digitally archiving the work stored at NCC continues. Eventually all the work will be available to Members at the DSA website, or furnished to sister organizations like the Dozenal Society of Great Britain. Even though the physical collection has been dispersed, the material will be available on a broad scale.

Issues of the Modular Conversion Bureau's newsletter, salvaged and now part of a satellite library, to be scanned and preserved in St. Louis.



Circular slide rules and a long dozenal slide rule were among the materials salvaged. The materials can be seen at the Editor's office on appointment.

Expanded DSA Website

The Society has maintained a website for a few years: we'd revamped it in January 11Ɛ6; (2010.), the most notable feature added then was the digital archive of the *Duodecimal Bulletin*. In late 2012, Don Goodman III planned and executed a major expansion of functionality through Drupal. The site went live on 26 February 11Ɛ9; (2013.). Over the year, the site has accumulated several significant functions; many were part of this update from the start. Here is a summary of the most important new features:

1.) Search available. One can search the text of the website. This does not necessarily extend to text that appears in the *Duodecimal Bulletin* scans, however certain optically-recognized text in the *Bulletins* does appear in some searches.
2.) The full library of past issues of the *Duodecimal Bulletin* is now available. Originally the library ran to approximately year 11Ɛ2;. You'll need Member access to view the latest issue of the *Bulletin*, but all back issues can be retrieved electronically.
3.) Dozenal arithmetic practice pages. Build proficiency in dozenal arithmetic! The page generates a problem in an operation you request. Type in your answer, and the page script will signal whether you're right or wrong. If you're wrong, the script yields the correct answer. You can repeat practice as often as desired.
4.) Dozenal divisibility tests. We're all familiar with handy decimal divisibility tests; checking evenness, divisibility by 5, by 3 or 9 using the digit sum, or 6 using evenness and the test for 3 combined. We can test for divisibility in dozenal! Many of the dozenal tests (i.e., those for 2, 3, 4, and 6) are as easy as the decimal evenness or divisibility-by-5 tests. Check out this page for the dozenal divisibility tests.
5.) A "What's New" page. The page is automatically updated when we add new content to the website.
6.) An expanded "Resources" page. Find tools, fonts, and so forth that can be downloaded to your system, so that you can produce your own dozenal documents!
7.) Two new Membership forms. You can fill out a web form and submit it online. www.dozenal.org/drupal/content/member-signup. If you prefer, there is a fillable PDF that you can type into to fill out and send in via mail. The original membership form is of course still available.
8.) Organizational information. Take a look at the Minutes of the two most recent Annual Membership and Board Meetings, and a roster of current and past Officers and Board Members.
9.) Social media links. The Society maintains Twitter and Facebook accounts, each with more than 200; Members. Interact with the DSA through these avenues. The website introduces an RSS feed, and users can choose to share our pages in any of twelve different ways (eleven social networks plus email) with a single click on the website.
χ.) Donate button. You can support the Society through PayPal! It's fast and easy. www.dozenal.org/drupal/content/donate.

Make a Dozenal Difference!

If you're a lover of dozenal, please consider a modest donation. The things we volunteers do are done out of love. Your donation helps the organization produce the *Bulletin* and maintain the website, as well as advocate and educate the world as to the usefulness of the dozen.

Systematic Dozenal Nomenclature

John Kodegadulo

Introduction.

Systematic Dozenal Nomenclature (SDN) is a new scheme for expressing dozenal numbers in word form, based on familiar numeric word-roots derived from classical Latin and Greek. SDN was recently developed as a result of an extended discussion this author had with a number of other dozenalists collaborating over the Web on the DozensOnline forum.

SDN is inspired in part by the Systematic Element Namescheme used by the International Union of Pure and Applied Chemistry (IUPAC). Whenever a new trans-Uranium chemical element is synthesized in the laboratory, IUPAC systematically generates a temporary name for it based on its (decimal) atomic number. In fact, SDN actually subsumes this element naming scheme (with dozenal extensions) as a part of its own system.

SDN is also inspired by the dozenal-metric prefix system which Tom Pendlebury devised as an adjunct to his TGM system of measurement units. In fact, a subset of SDN, the so-called "power prefixes," are structurally similar to (though superficially different from) Pendlebury's prefixes. These power prefixes are suitable for use with TGM units of measure, or indeed any system of measurement units.

However, SDN goes beyond both of these schemes, providing a robust and flexible numeric nomenclature with broad applicability.

Digit Roots

At the heart of SDN is a simple set of twelve numeric word-roots distilled from classical Latin and Greek, one for each digit in dozenal arithmetic:

0;	1;	2;	3;	4;	5;
nil	un	bi	tri	quad	pent
6;	7;	8;	9;	χ;	Ɛ;
hex	sept	oct	enn	dec	lev

Table 1. SDN Digit Roots.

We refer to these as "roots" rather than "words" because SDN does not simply leave them to stand alone as words by themselves. Instead, as we will see shortly, SDN provides various ways to glue these roots together with other syllables to form compound words.

The first ten of these, nil through enn, are identical to the roots which IUPAC uses to express atomic numbers within systematic chemical element names. IUPAC carefully selected from among the various available Latin and Greek words for numbers, so that each of these roots would start with a unique letter. This makes them amenable to single-letter abbreviations.

Extending this into a dozenal scheme, of course, requires two more digits. Given the classical theme, the obvious choice for digit ten is *"dec"*. The only truly new coinage is *"lev"*, which is clearly a contraction for English "eleven." However, even lev could be granted a classical etymology, if we imagine it deriving from Latin *lævus* (combination forms *lævo, levo, lev*), which signifies "to the left." Eleven is, after all, the integer just to the left of twelve on the number line! Fortuitously, these two additions also start with unique initials, preserving our ability to use single-letter abbreviations for them.

Digit Strings and Element Names

With just these twelve roots, we can (at least in principle) represent any whole number: We can simply string roots together in the same manner we string together Hindu-Arabic digits to form multi-digit numerals, relying on the familiar place-value arithmetic system. This is what IUPAC's systematic element names do in order to express their atomic numbers, which are now well into three (decimal) digits at the bottom of the periodic table.

For instance, as of this writing, the latest element synthesized in the laboratory has (decimal) atomic number 118· (one hundred eighteen). Consequently, IUPAC has assigned it the temporary name *ununoctium* (abbreviation Uuo). This name is assembled from the digit roots *un* (one) in the hundredths place, *un* (one) in the tens place, and *oct* (eight) in the units place, plus the common suffix *-ium* for a chemical element.

Of course in dozenal this atomic number is 9χ; (nine dozen ten). Consequently, the SDN version of this element name pastes together the digit roots *enn* (nine) in the dozens place and *dec* (ten) in the units place. To these we attach *–izium*, the chemical element suffix marked with a *z* to distinguish the element name as dozenal rather than decimal. The resultant element name is "*enndecizium*". Its abbreviation, Edz, is also marked with a *z* to denote its dozenal provenance.

For the next heavier element, atomic number 119· (one hundred nineteen) or 9Ɛ; (nine dozen eleven), IUPAC will generate the decimal name *ununennium* (abbreviation Uue), whereas SDN will generate the dozenal name *"ennlevizium"* (abbreviation Elz). For the element after that, atomic number 120· (one hundred twenty) or χ0; (ten dozen), the corresponding names will be decimal *unbinilium* (abbreviation Ubn) and dozenal *"decnilizium"* (abbreviation Dnz). Notably, both of the latter names feature the root nil, highlighting the vital importance of digit-0 for place-value arithmetic, be it decimal or dozenal.

SDN Prefixes

Systematic dozenal nomenclature goes well beyond chemical elements, however. From strings of these twelve basic roots, SDN derives two different types of numeric prefixes with broad applications: multiplier and power prefixes. Both types amend the basic digit string with an extra final syllable that clearly distinguishes what kind of prefix it is, and also provides a point of attachment to a following word.

Multiplier Prefixes

A multiplier prefix simply indicates that the word attached to it is to be multiplied by the whole number encoded in the string of digit roots. The first dozen of these multiplier prefixes are as follows:

0; ×	1; ×	2; ×	3; ×	4; ×	5; ×
nili-	uni-	bina- bi-	trina- tri-	quadra-	penta-
6; ×	7; ×	8; ×	9; ×	χ; ×	Ɛ; ×
hexa-	septa-	octa-	ennea-	deca-	leva-

Table 2. SDN Digit Roots for zero through eleven.

If these seem familiar, that is by design. These multiplier prefixes are intended to resemble, as much as possible, the numeric combination forms already in common use, while at the same time regularizing them. Generally speaking, a multiplier prefix is formed by attaching a connecting *-a-* or *-i-* onto the end of the digit string. If the string represents a multi-digit number, only the final root in the string gets this extra syllable. The choice of which ending to add is based on which vowel usually appears in the original numeric combination form for that final root. In fact, sometimes either vowel can be used interchangeably, as acceptable variants with no difference in meaning.

In some cases, another letter is interposed between the final root and the connecting vowel: specifically, the *-n-* in *bina-* , *trina-* ; the *-r-* in *quadra-*; and the *-e-* in *ennea-*. In these cases, this is done to make the resulting prefix easier to say and hear (i.e., to make it more "euphonious"). This also serves to recover the original spelling of the classical combination form. Indeed, one of the design goals of SDN was to avoid overloading these pre-existing forms with new meanings. SDN achieves this goal by simply incorporating those forms, with their existing meanings, as instances of SDN!

So, for example, the word *quadrilateral* still refers to a four-sided polygon. *Pentagon* still refers to a five-sided polygon, while *pentameter* still refers to a style of poetry with a five-beat rhythm. In a similar vein, a *"pentaminute"* would be a block of time equal to five minutes, or one twelfth of an hour. A *hexahedron* (i.e., a cube) and an *octahedron* are still Platonic solids with six and eight faces, respectively; just as *hexane* and *octane* still refer to hydrocarbon compounds with six and eight carbon atoms, respectively. A week of seven days would be a *"septaday",* and so forth.

When a multiplier is prefixed onto a word that begins with a vowel, the final connecting vowel of the prefix can be elided. Thus, given the common suffix *-ennium* or *-ennial,* referring to a period of time measured in years, the *-a-* in *quadra-* can be elided to yield *quadrennial* (the frequency of presidential elections in the United States). Similarly, the *-a-* in *hexa-* can be elided to yield *"hexennial"* (the frequency of senatorial elections in the United States).

Given that the word *ocular* relates to the eye, we can derive the word for a stereoscopic telescope with two eyepieces, by using the prefix *bina-* and eliding away the *-a-*, to yield *binocular.* (We can similarly derive *"trinoculars",* which would be a telescope suitable for a three-eyed space alien.)

In the case of *bina-* and *trina-,* the added syllable can sometimes be omitted. Since *bi-* and *tri-* already end in a vowel, that makes them amenable to attachment as prefixes themselves, reflecting pre-existing usage. This means *bicycle* (a pedal-powered vehicle with two wheels) and *tricycle* (a pedal-powered vehicle with three wheels) are perfectly good examples of SDN, as is *unicycle* (a pedal-powered vehicle with just one wheel) and *"quadracycle"* (a pedal-powered vehicle with four wheels). (A *"nilicycle"* would be a pedal-powered vehicle with zero wheels, the design and construction of which is left as an exercise for the reader.) On the other hand, we can see the final *-na-* syllable (or the variant *-ni-*) in such words as *binary, trinary,* and *trinity.* We shall soon see that there are certain instances where this syllable is necessary and not at all optional.

Of course, multiplier prefixes are not limited to representing only single-digit numbers. Just as in the element names, digit roots can be concatenated to represent as many digits as necessary, relying on position to indicate their place-value. The next couple dozen multiplier prefixes are shown by Table 3.

10; ×	11; ×	12; ×	13; ×	14; ×	15; ×
unnili-	ununi-	unbina- unbi-	untrina- untri-	unquadra-	unpenta-
16; ×	17; ×	18; ×	19; ×	1X; ×	1Ɛ; ×
unhexa-	unsepta-	unocta-	unennea-	undeca-	unleva-
20; ×	21; ×	22; ×	23; ×	24; ×	25; ×
binili-	biuni-	bibina- bibi-	bitrina- bitri-	biquadra-	bipenta-
26; ×	27; ×	28; ×	29; ×	2X; ×	2Ɛ; ×
bihexa-	bisepta-	biocta-	biennea-	bideca-	bileva-

Table 3. SDN Digit Roots for one dozen through two dozen eleven.

This is where SDN diverges from pre-existing numeric word-forms to create a more regular system. Where the standard decimal nomenclature involves unique Latin or Greek words for multiples of ten and hundred, SDN multiplier prefixes dispense with any need for similar forms for multiples of dozen and gross. Instead, SDN simply relies on the place-value system to endow each digit root with its scale.

So for instance, the *dodecahedron* and *icosahedron* are Platonic solids with decimal 12· (twelve) and 20· (twenty) faces, respectively. In dozenal nomenclature, these become the *"unnilihedron"* and *"unoctahedron",* solids with 10; (dozen) and 18; (dozen-eight) faces, respectively.

Decimal nomenclature refers to numeric bases twelve, sixteen, and twenty as *duodecimal, hexadecimal,* and *vigesimal.* SDN can refer to bases dozen, dozen-four, and dozen-eight as *"unnilimal", "unquadral",* and *"unoctal".*

Where decimal language would refer to a superstitious dread of the number thirteen as *triskaidekaphobia,* SDN would call it *"ununiphobia",* fear of the number dozen-one.

A fortnight of fourteen or dozen-two days can be described as an *"unbiday".* Similarly a British stone of fourteen or dozen-two pounds can be described as an *"unbipound".*

The TGM equivalent of a minute, a duration of one gross Tims, is one-twelfth of a *"pentaminute".* This is 25· (twenty-five) or 21; (two dozen one) seconds long. In SDN, this can be referred to as a *"biunisecond".*

In SDN, an hour of sixty, or five dozen, minutes can be called a *"pentniliminute",* and a minute a *"pentnilisecond".* Similarly, base sixty, known decimally as *sexagesimal,* can become base five dozen, or *"pentnilimal"* in SDN.

A thirty-day month (two dozen six days) can be called a *"bihexaday",* while a thirty-one-day month (two dozen seven days) would be a *"biseptaday".* A short February of 28· or 24; days would be a *"biquadraday",* while a February in a leap year would be a *"bipentaday".*

Note that, while each of these prefixes constitutes a multiplier, each of the digit roots within them do not act as multipliers individually. For instance, in *"bihexaday",* the *bi* is not a multiplier on the hex. If that were so, then the whole prefix would represent 2 × 6 = 10;, one dozen. Instead, using the familiar place-value system, the *bi* and the *hex* together represent the number 26; (two dozen six), so that the whole prefix *bihexa-* concatenated with the word day represents 26; days.

Venturing into three digits, a year of 365· (three hundred sixty-five) or 265; (two gross six dozen five) days can be referred to as a *"bihexpentaday"*. A leap year of 366· (three hundred sixty-six) or 266; (two gross six dozen six) days would be a *"bihexhexaday"*.

In four digits, a *conventional mile* of decimal 5280· (five thousand two hundred eighty) or dozenal 3080; (three great gross eight dozen) feet could be described as a *"triniloctnilifoot"*. A *nautical mile* of decimal 6080· (six thousand eighty) or dozenal 3628; (three great gross six gross two dozen eight) feet would be a *"trihexbioctafoot"*. A *kilometer* of 1000· (one thousand) or 6↋4; (six gross eleven dozen four) meters becomes a *"hexlevquadrameter"* in SDN.

In theory, any whole number may be represented by an SDN multiplier prefix. In practice, however, there is a point of diminishing returns after which appending any more digit roots, even if they are just *nil,* starts to make the prefix too unwieldy. While *unnili-* for one dozen may be palatable, and perhaps *unnilnili-* for one gross might be tolerable, beyond that *unnilnilnili-* for one zagier and so forth become just too unmanageable. Clearly, some more compact way of referring to large numbers is needed. SDN provides a compact reference for large numbers through its power prefixes.

Power Prefixes

Power prefixes are SDN's signature feature. As the term suggests, they represent powers of twelve. Just like a multiplier prefix, each power prefix starts with a string of digit roots. However, unlike a multiplier prefix, the digit string in a power prefix does not encode a simple whole number. Instead, it encodes the *exponent* for a power of twelve. SDN clearly marks the power prefixes as dozenal powers, by concatenating the digits strings with novel and distinctive endings not found in pre-existing numeric word-forms. SDN further distinguishes the *positive* powers of twelve from their reciprocals, the *negative* powers of twelve, by using distinctly different endings for positive versus negative powers.

The first dozen positive power prefixes are:

$10;^{0}$	$10;^{1}$	$10;^{2}$	$10;^{3}$	$10;^{4}$	$10;^{5}$
nilqua-	unqua-	biqua-	triqua-	quadqua-	pentqua-
$10;^{6}$	$10;^{7}$	$10;^{8}$	$10;^{9}$	$10;^{↊}$	$10;^{↋}$
hexqua-	septqua-	octqua-	ennqua-	decqua-	levqua-

Table 4. SDN Power Prefixes for the zeroth through eleventh positive powers of twelve.

The first dozen negative power prefixes are:

$10;^{-0}$	$10;^{-1}$	$10;^{-2}$	$10;^{-3}$	$10;^{-4}$	$10;^{-5}$
nilcia-	uncia-	bicia-	tricia-	quadcia-	pentcia-
$10;^{-6}$	$10;^{-7}$	$10;^{-8}$	$10;^{-9}$	$10;^{-↊}$	$10;^{-↋}$
hexcia-	septcia-	octcia-	enncia-	deccia-	levcia-

Table 5. SDN Power Prefixes for the zeroth through eleventh negative powers of twelve.

As shown, a positive power is formed by marking a digit string with a *-qua-* syllable (with suggested English pronunciation /kwə/). Its corresponding reciprocal, a negative power, is formed by marking the same digit string with a *-cia-* syllable (with suggested English pronunciation /sjə/ or /ʃə/). The contrast of a hard *q* sound merging into the labial glide of the *u*, versus the soft *c* sound merging into the fronted glide of the *i*, clearly distinguish these endings from each other. Furthermore, these are novel endings that will not be confused with any prior usage, including the endings marking the multiplier prefixes.

The positive power prefixes are also known as the unqual prefixes, after *unqua-*, the prefix for twelve to the first power ($10;^{1}$). Similarly, the negative power prefixes are known as the uncial prefixes, after uncia-, the prefix for twelve to the negative first power ($10;^{-1}$). Notably, the latter prefix is identical to the ancient Latin word *uncia,* which literally meant "one twelfth." (The English word *inch,* meaning "a twelfth of a foot," as well as *ounce,* originally meaning "a twelfth of a pound", are both derived from Latin *uncia*.) The Romans, as it turns out, had a robust system of words for common fractions, thoroughly dozenal in nature, with *uncia* as the centerpiece. Including this word as a power prefix in SDN was a deliberate coincidence.

Higher orders of magnitude, with exponents containing multiple digits, can be represented by simply concatenating multiple roots into a string before the final power-marking syllable, just as multi-digit whole numbers can be represented by stringing multiple roots before the final multiplier-marking vowel.

So for instance, the next couple dozen positive power prefixes are:

$10;^{10}$	$10;^{11}$	$10;^{12}$	$10;^{13}$	$10;^{14}$	$10;^{15}$
unnilqua-	ununqua-	unbiqua-	untriqua-	unquadqua-	unpentqua-
$10;^{16}$	$10;^{17}$	$10;^{18}$	$10;^{19}$	$10;^{1↊}$	$10;^{1↋}$
unhexqua-	unseptqua-	unoctqua-	unennqua-	undecqua-	unlevqua-
$10;^{20}$	$10;^{21}$	$10;^{22}$	$10;^{23}$	$10;^{24}$	$10;^{25}$
binilqua-	biunqua-	bibiqua-	bitriqua-	biquadqua-	bipentqua-
$10;^{26}$	$10;^{27}$	$10;^{28}$	$10;^{29}$	$10;^{2↊}$	$10;^{2↋}$
bihexqua-	biseptqua-	bioctqua-	biennqua-	bidecqua-	bilevqua-

Table 6. SDN Power Prefixes for the dozenth through two dozen eleventh positive powers of twelve.

$10;^{-10}$	$10;^{-11}$	$10;^{-12}$	$10;^{-13}$	$10;^{-14}$	$10;^{-15}$
unnilcia-	ununcia-	unbicia-	untricia-	unquadcia-	unpentcia-
$10;^{-16}$	$10;^{-17}$	$10;^{-18}$	$10;^{-19}$	$10;^{-1↊}$	$10;^{-1↋}$
unhexcia-	unseptcia-	unoctcia-	unenncia-	undeccia-	unlevcia-
$10;^{-20}$	$10;^{-21}$	$10;^{-22}$	$10;^{-23}$	$10;^{-24}$	$10;^{-25}$
binilcia-	biuncia-	bibicia-	bitricia-	biquadcia-	bipentcia-
$10;^{-26}$	$10;^{-27}$	$10;^{-28}$	$10;^{-29}$	$10;^{-2↊}$	$10;^{-2↋}$
bihexcia-	biseptcia-	bioctcia-	bienncia-	bideccia-	bilevcia-

Table 7. SDN Power Prefixes for the dozenth through two dozen eleventh negative powers of twelve.

The most important use of power prefixes is to serve as dozenal equivalents for the decimal prefixes provided by the Metric System, or as it is now styled, the International System of Units (SI). SDN power prefixes represent orders of magnitude just as the SI prefixes do, albeit SDN's are dozenal rather than decimal. Unlike SI, SDN requires no formal committee to coin ad hoc new names for ever greater orders of magnitude. As demonstrated, we can generate SDN power prefixes in a completely systematic way, using just the twelve dozenal roots. In fact, where SI can only manage to assign a prefix to every *third* order of decimal magnitude (every power of one thousand), SDN is able to construct a prefix for *every* order of dozenal magnitude, because of this systematic scheme.

In this regard, SDN's power prefixes are similar to those which Pendlebury devised for his TGM system. Pendlebury also derived his prefixes from familiar classical Latin and Greek roots, appending them systematically to achieve any desired order of magnitude. However, when facing the issue of how to distinguish his prefixes from pre-existing numeric forms, Pendlebury picked a very different strategy. Rather than keeping those forms intact and appending a distinctive ending, Pendlebury chose to mutate the classical roots in ad hoc, and in some cases, rather odd ways. In this author's opinion, this rendered his prefixes unnecessarily alien to most people already comfortable with Latin and Greek numeric forms.

However, SDN power prefixes do work quite well with the unit names from Pendlebury's TGM system. Thus, a one-dozen-Tim duration (slightly more than 2 seconds) can be called an *"unquaTim"*. A one-gross-Tim duration (25· seconds) can be called a *"biquaTim"*. A one-zagier-Tim duration (5 minutes or 1 pentaminute) can be called a *"triquaTim"*. A dozen-zagier Tim duration (1 hour) can be called a *"quadquaTim"*. A day is equivalent to 2 *"pentquaTim",* a month is about 5 *"hexquaTim",* and a year is a bit more than 5 *"septquaTim"*. A dozenth of a Tim is an *"unciaTim",* a dozenth of that (about 1·2 milliseconds) is a *"biciaTim",* and a dozenth of that (about a tenth of a millisecond) is a *"triciaTim"*.

Similarly, a one-dozen-Grafut length (about twelve feet) can be called an *"unquaGrafut",* a one-gross-Grafut length can be called a *"biquaGrafut",* a one-zagier-Grafut length (about a third of a mile or half a kilometer) can be called a *"triquaGrafut",* and a dozen-zagier Grafut length (about 3·8 miles, somewhat longer than a league) can be called a *"quadquaGrafut"*. A dozenth of a Grafut (about an inch) can be called an *"unciaGrafut",* a dozenth of that (about 2 millimeters) a *"biciaGrafut",* a dozenth of that a *"triciaGrafut",* and a dozenth of that a *"quadciaGrafut"*.

Notice, for example, the clear distinction between a *"triGrafut"* (a three-Grafut length, about a yard) using the multiplier prefix *tri(na)-,* versus a *"triquaGrafut"* (a one-zagier-Grafut length, about a third of a mile) using the power prefix *triqua-*.

SDN power prefixes are suitable for use not just with TGM, but with any dozenally-based system of measurement units, for instance Takashi Suga's Universal Unit System (UUS). In fact, there is nothing in principle to restrict applying SDN prefixes to other systems of measure that are not inherently dozenal, such as SI or Imperial units. Thus we might speak of *"unquameters"* or *"biciagrams"* or *"triquafeet"* or *"hexciaseconds"* or *"septquapounds",* and so forth. However, SDN is most "at home" with dozenal metrologies.

Power prefixes can be used in other contexts beyond just units of measure. For instance, a *dodecahedron* can not only be called an *"unnilihedron"* (using the SDN multiplier prefix), it can also be called an *"unquahedron"* (using the SDN power prefix). And of course, the dozenal base itself can be called not only *"unnilimal"* (meaning "base one-zero") but also *"unqual"* (meaning "base dozen-to-the-first").

Combining Multiplier and Power Prefixes

So far, we have seen that multiplier prefixes allow us to express any whole number, although they do become quite tedious if the number is very large and requires a long string of *nils*. And power prefixes allow us to express very large (or very tiny) numbers in a compact way, although they are strictly limited to exact powers of twelve. However, by simply concatenating a multiplier prefix with a power prefix, we gain a great deal of versatility to express arbitrary whole numbers.

For instance, since a day is two gross zagier Tims (200,000; = 2 × $10;^{5}$ Tm), we can call it a *"binapentquaTim"*. In this case the *bina-* is a multiplier prefix signifying 2, and the pentqua- is a power prefix signifying $10;^{5}$. Note that the final syllable on the multiplier prefix is not optional in this case. If we were to omit the *-na-* and just use *bi-*, this would be indistinguishable from a digit root and would be interpreted as part of the power prefix *bipentqua-*, which means $10;^{25}$. Visually, it might help readers to hyphenate between the multiplier and power prefix: *"bina-pentquaTim"*. But the *-na-* syllable is still needed to make the distinction audible when spoken out loud.

Since a *"triquaGrafut"* is approximately a third of a mile, or a half a kilometer, we could speak of a *"trina-triquaGrafut"* (3 × $10;^{3}$ Gf) as a TGM approximation of a mile, and a bina triquaGrafut (2 × $10;^{3}$ Gf) as a TGM approximation of a kilometer. (The colloquial names *gravmile* and *gravkay*, respectively, have been suggested for these lengths.)

Since an *"unciaVolm"* ($10;^{-1}$ Vm) is intermediate between a U.S. and Imperial half-gallon, two of these (2 × $10;^{-1}$ Vm) would approximate a gallon in either system. This could be called a *"bina-unciaVolm"* (although Pendlebury himself suggested the colloquial name *galvol* for this, and *halvol* has been suggested as a colloquialism for the *"unciaVolm"*).

Half an *"unciaVolm"*, i.e. 6 *"biciaVolm"* (6 × $10;^{-2}$ Vm) approximates a U.S. or Imperial quart. This amount could be called a *"hexa-biciaVolm"*. (Pendlebury suggested the colloquialism *quartol*.)

Half of this, 3 *"biciaVolm"* (3 × $10;^{-2}$ Vm) approximates a U.S. or Imperial pint. This could be called a *"trina-biciaVolm"*. (Pendlebury suggested the colloquialism *tumblol*, although *pintvol* has also been suggested.)

Half of this again, 16; *"triciaVolm"* (16; × $10;^{-3}$ Vm) approximates a U.S. or Imperial cup. This could be called an *"unhexa-triciaVolm"*. (The colloquialism *cupvol* has been suggested.)

One ninth of this, 2 *"triciaVolm"* (2 × $10;^{-3}$ Vm) approximates a U.S. or Imperial fluid ounce (fl. oz.). This could be called a *"bina-triciaVolm"*. (The colloquialism *ozvol* has been suggested. Since there are 8 fluid ounces per U.S. cup, and 10· fluid ounces per Imperial cup, a ratio of 9 *ozvol* per *cupvol* makes a nice compromise. Also, dividing the *galvol* by four powers of 2 to get to the *cupvol* has strayed us into what seems to be a binary system, but dividing by two powers of 3 at this point makes the *ozvol* one pergross of a *galvol*, returning us to a dozenal system.)

Dividing by two again yields one *"triciaVolm"* ($10;^{-3}$ Vm). This happens to approximate a U.S. or Imperial tablespoon (approximately 15· ml). (The colloquialism *supvol* has been suggested, the *"sup"* indicating that this is a "supper" or "soup" spoon.)

A third of this, or 4 *"quadciaVolm"* (4 × $10;^{-4}$ Vm), approximates a U.S. or Imperial teaspoon (approximately 5· ml). This could be called a *"quadra-quadciaVolm"*. (The colloquialism *sipvol* has been suggested, since this kind of spoon gives you just a sip of tea.)

These combination forms are not limited to decorating only units of measurement, of course. For instance, base sexagesimal can not only be called *"pentnilimal"* ("base five-zero") using the multiplier prefix, it can also be called *"penta-unqual"* (base "five times dozen to the first") using a combination form. Similarly, base 120· or χ0⁝, i.e., the so-called "long hundred" base, can be called either *"decnilimal"* or *"deca-unqual"*.

A 24·-cell (20⁝-cell), a four-dimensional Platonic hypersolid with two dozen octahedral cells is called a icositetrachoron. It can be called a *"binilichoron"* or a *"bina-unquachoron"* under SDN. Likewise, a 120· cell (χ0⁝-cell), a four-dimensional Platonic hypersolid with a long hundred *"unquahedral"* cells, can be called a *"decnilichoron"* or a *"deca-unquachoron"*.

In some of the examples above, the power prefix began with a vowel, which is slightly awkward for some people to pronounce directly after a multiplier prefix (which always ends in a vowel): *"bina-unciaVolm", "penta-unqual", "deca-unqual", "bina-unquachoron", "deca-unquachoron"*. (This situation can also occur if the power prefix is *octqua-, octcia-, ennqua-,* or *enncia-,* but *unqua-* and *uncia-* are more common.) The hyphen provides some assistance, but SDN does offer an optional feature that can work around this issue: append an extra *-n-* onto the multiplier prefix. Hence we can have: *"binan-unciaVolm", "pentan-unqual", "decan-unqual", "binan-unquachoron", "decan-unquachoron"*. This extra *-n-* does not change the meaning and is entirely optional. It is just there for "euphony", i.e., to make the whole word easier to pronounce and easier to understand when heard.

Another strategy, in the case of multiplier prefixes that already have extra euphony letters (i.e. *bina-, trina-, quadra-, ennea-*) is to elide the final *-a-* before the following vowel. Hence, we can have: *binuncia-, trinuncia-, quadruncia-, enne-uncia-,* signifying 2 × 10⁝$^{-1}$, 3 × 10⁝$^{-1}$, 4 × 10⁝$^{-1}$, 9 × 10⁝$^{-1}$. However, these might be difficult to distinguish from *biuncia-, triuncia-, quaduncia-, ennuncia-,* which signify 10⁝$^{-21}$, 10⁝$^{-31}$, 10⁝$^{-41}$, 10⁝$^{-91}$. So use this option with a grain of salt.

Adding a Dash of "Dit"...

With the combination forms above, we can now express any whole multiple of any power of a dozen. This scheme, in word form, is beginning to resemble what scientific notation does with mathematical symbols. In fact, only one more element is needed to completely reproduce scientific notation with words: some way of expressing a radix point. Note that this would be a dozenal point, not a decimal point.

Fortunately, there is a ready pronunciation for such a radix point: When a semicolon is used as a so-called "Humphrey point", it is customary to pronounce it "dit," in contrast to pronouncing a decimal point as "dot". (This "dit" pronunciation could certainly be granted to any symbol used as a dozenal point, including the vertical ellipsis [⁝] used in this article.) Accordingly, SDN incorporates *dit* as a syllable that is acceptable within a multiplier prefix.

Recall our previous example giving the systematic name for the *cupvol* as the *"unhexa-triciaVolm"* (16⁝ × 10⁝$^{-3}$ Vm). This can now be rendered equivalently as *"undithexa-biciaVolm"* (1⁝6 × 10⁝$^{-2}$ Vm), or even as *"ditunhexa-unciaVolm"* (0⁝16 × 10⁝$^{-1}$ Vm).

One twelfth of an hour, a *"triquaTim",* is equivalent to 1 *pentaminute,* a 5-minute block of time. One twelfth of this, a *"biquaTim",* is equivalent to 1 *"biunisecond"* (25· or 21⁝ seconds). To continue dividing by twelve will require using *dit*: An *"unquaTim"* is equivalent to 2⁝1 seconds, so it can be described as a *"biditunisecond"*. Dividing once more by twelve yields the Tim itself, which is equivalent to 0⁝21 second. This can be described using SDN as a *"ditbiunisecond"*.

As shown, the *dit* syllable may appear between multiplier digits, or even at the start of the multiplier prefix. (A *dit* following all the digits would be redundant and is not allowed.) No more than one *dit* may appear, somewhere among the digit roots.

With this feature, SDN can now render any value that can be expressed in the dozenal version of scientific notation. However, this has not actually increased the number of rational numbers we can express, because any such numbers can always be recast as a whole-number multiple of some different power of dozen. All that introducing *dit* has done is provided more flexible ways of expressing the same values.

… and a Pinch of "Per"

To actually render even more rational numbers requires one more feature: an optional per syllable as part of a multiplier prefix. What this syllable does is divide the digits of a multiplier into a numerator string and a denominator string, expressing an arbitrary fraction.

For example, if we wish to express lengths of 5⁄7 Gf (five-sevenths of a Grafut) or 7⁄5 Gf (seven-fifths of a Grafut), neither can be expressed exactly in dozenal scientific notation, because neither 7 nor 5 are factors of twelve. However, using a *per* syllable, we can describe these as a *"pentperseptaGrafut"* and a *"septperpentaGrafut"*, respectively.

At most one *per* may appear within a multiplier prefix, as long as it is followed by at least one digit root for a denominator. The *per* may be the first element in the multiplier prefix, in which case the numerator is presumed to be 1, without the need for a preceding *un* syllable. So, for instance, if a teaspoon is one third of a tablespoon, and hence one sipvol is one-third of a supvol, and the supvol is exactly 1 *"triciaVolm"*, then the sipvol can be described as a *"pertrina-triciaVolm"*.

If a *"biquaTim"* is equivalent to 21; seconds, then we can take the reciprocal and say that one second is equivalent to 1⁄21; of a *"biquaTim"*. Using *per*, this can be described as a *"perbiuni-biquaTim"*.

Conclusion

In summary, SDN takes a set of just one dozen numeric roots, adds three distinctive prefix endings (*-a-/-i-*, *-qua-* and *-cia-*), plus two optional syllables (*dit* and *per*), and from those basic elements derives an arbitrarily extensible system of numeric prefixes that may be applied to a variety of purposes and with great flexibility. The roots themselves should be readily recognizable, not only to dedicated dozenalists, but in fact to anyone reasonably acquainted with existing numeric combination forms, and certainly to anyone conversant with IUPAC's standards. By capitalizing on such an international standard (and in fact incorporating it wholesale), while at the same time clearly distinguishing the new dozenal features, the expectation is that this will maximize the likelihood that a systematic nomenclature based on dozenal arithmetic can achieve broad acceptance.

Editor's Notes: words in italics are subjects of discussion; those that are in quotes are words proposed by SDN. Roots and components proposed by SDN appear without quotes.

Mr. Kodegadulo developed the Systematic Dozenal Nomenclature system in a discussion thread at the DozensOnline Forum in November 2011. The thread remains open and conversation continues regarding SDN. View detail applications for the system and the evolution of the basics presented here at http://z13.invisionfree.com/DozensOnline.

The DozensOnline Forum is a virtual location for discussion of all things duodecimal. It began as a project of the Dozenal Society of Great Britain in August 2005 and is moderated by Mr. Shaun Ferguson, Mr. Bryan Parry, and our own Mr. Don Goodman III. The Editor is a member and participant in the Forum, as is Mr. Kodegadulo. Typically some sort of conversation is underway daily. Please join us and share your thoughts on duodecimal and related topics! We are a friendly bunch!

The 12/12/12 Effect

Some of us saw it coming. More importantly, the world awaited it—12 December 2012 would be the day the world tipped its hat to our favorite number. It was time to toast its significance in our daily lives.

The publicity on that day represents perhaps the single most prominent such event in the history of the Society because of its global reach and the immediacy and ubiquity of telecommunications. It appears to have reached millions in the span of a day. The coverage is on the whole light and positive, celebratory. Our objective was to attempt to ensure the Society and twelvefoldness wasn't viewed as weird, but practical and simple.

The following took place between 4 PM 11 December and 7 PM 12 December 2012.

1. British author Alex Bellos interviewed President Don Goodman III last week in an article for *the Guardian's* blog, for a time on the front page.
2. Bellos' interview was echoed at *Le Monde* and *Ha'Arretz*.
3. ABC Australia Pacific Radio interviewed me. The interview lasted 8:27 minutes and aired at 12:12 PM local time. Radio Ireland called in but did not run an interview.
4. Danbury (CT) *News-Times*, mentioned the Society on the front page but later moved it to "Weird News".
5. *USA Today*, Janice Lloyd interviewed President Don Goodman III, in an article still available on the site.
6. Dr. James Grime produced an enthusiastic 9 minute introduction to duodecimals as part of YouTube's *Numberphile* series which has seen nearly 28,000; views as of 5 PM EST that day.
7. We gained 25; Twitter followers (@dozenal), going from about 30; to 55; total. (The total now is a couple gross). I had a dozen conversations with enthusiasts on Twitter, including James Grime. Throughout the day I posted links to Schiffman's fundamental arithmetic, Zirkel's basics, Dr. Impagliazzo's music, and more.
8. We've gained about three dozen followers on Facebook, again I've interacted with several. We have Χ9; likes, meaning our posts reach that many folks via Facebook in their daily feeds. (There are now over a gross likes).
9. We saw the beginnings of a spike in interest in the web statistics in the first 8 hours of the event (that which happened between 4 PM and 12 AM server time). Visitors to the website spiked one gross times the normal daily average, maintaining a dozen times the daily average through January when the website was renovated. The renovation brought that level to a new plateau, roughly doubling the traffic sustained in the wake of the spike. The spike in interest led to lasting interest in the subject worldwide.

Χ. The Dozenal Society of Great Britain experienced a similar spike in interest.

Ɛ. The AMS produced an interesting story about dozens.

10. *CBS Evening News* wrote in asking whether there was a word for those fond of twelve. I suggested "dodekaphile", a favorite of long time Editor Gene Zirkel's, with duodecimalist and dozenalist more pertinent to those who use base twelve. This led to its being applied at 6:53 PM EST on national news, and the nearly nine dozen searches registered in the web stats.

The international media phoned in early in the week, arranging interviews. NBC Universal phoned casting for someone to join them at Times Square for the *Nightly News*. Member Dan Simon and his mother rushed down there to catch the call, but didn't make it in time. Famous media mavens phoned in as if we were celebrities.

The Radio Australia interview focused on the utility of the number twelve. The interviewer asked why 12 is special, and I mentioned divisors. Because of these divisors, the five commonest (i.e. "natural") fractions (½, ⅓, ⅔, ¼, ¾) yield whole numbers when we divide the dozen. She asked about practicality, and I pointed to the clock and calendar. For example, we have a day of three 8 hour shifts. If it were decimalized, we'd have a messy 3.3333… "hours" per shift. She explored the meaning of the term "dozenal". I replied it was a way to escape "ten-ness" via "decimal" in "duodecimal", but we didn't escape very far. Dozen comes from French *douzaine*, which eventually gets us back to "duodecimal." It means the same thing. She asked, "So only this division stuff then," and I replied, saying the dozen is actually quite practical. Many things are sold by the dozen because it packs well, and yes, it can be divided in many common ways so as not to need to break a unit. She agreed, using eggs as an example. She asked about accommodating dozenal via special language and I suggested it was possible simply to count dozenally in plain English. I was asked to count to 24, so I counted 9, ten, eleven, one dozen, one dozen one, ... one dozen eleven, two dozen—quite natural English. She asked about numerals and I agreed, we write the number 120 dozenally with two digits, a digit-ten and a zero. She suggested we didn't have "decimals," but I suggested we do, using a radix point we'd write one and a half as 1;6. Clearly it was more than touching on superficial curios.

The 12/12/12 event was the largest spike in viewership of the DSA website. In days, more than 4 times the average monthly traffic visited the site to read about the number twelve. About 3,000; individuals accessed the site in the first 23; hours, with about a third staying on and delving deeper. Roughly half the visits looked at the home page and went on about their day. The other half viewed some of the standalone articles, about a sixth visiting the *Bulletin* Archive. The busiest hour of the spike was 4-5 PM server time. This seems to indicate folks checking in after hearing 12/12/12 all day at work, or perhaps seeing coverage on the evening news. The 4 PM surge saw more traffic in one hour than half an average week.

In those first couple dozen hours, the web searches that reached the site mostly involved the terms "dodekaphile" and "dozenal," some searching for the Society by name, some for the duodecimal system. Several referrals derived from Alex Bellos' interview with our President. Grosses of searches poured in via Google, 260; from *Le Monde*, 172; from *the Guardian*, 156; from Facebook. One dozen one visitors from the Mental Floss blog tapped our site. That week, traffic streamed in from the US, France, the UK, with Canada, Australia, Europe, Russia, Israel, Japan, and China. Five out of six visits were new visits. A single IP in Yuma visited 300; page views that week.

The Society's Founder F. Emerson Andrews reached many through the *Atlantic Monthly*, and touched off the Society. In the 1970s, ABC showed the *Little Twelvetoes* animated short on Saturday mornings throughout the 70s and 80s. NPR interviewed Gene Zirkel in 1994. The 12/12/12 event stands alongside these as a significant publicity event. All involved participated in furthering the aim of our Society to educate the public on the benefits of the twelve system! We hope Mr. Emerson, Beard, Churchman, and the many others that followed and contributed do smile upon this day as the day the world marveled at twelve. All in all, it was a great day for dozens!

minutes BOARD & MEMBERSHIP 21; JULY 11Ɛ8;

21; (25.) July 11Ɛ8; (2012.)
Room D-3097
Nassau Community College
Garden City, NY 11530

Board Chair Jay Schiffman, President Mike De Vlieger, Board Members Gene Zirkel, Patricia Zirkel, Jen Seron, DSA Members John Impagliazzo, Graham Steele, Capt. Brian Ditter, Dan Simon, Don Goodman III (by phone) and guests Claire De Vlieger and Tara.

We did member presentations first and the business meeting afterward. Don Goodman, Judge from VA will be here virtually, via phone, at start of the business meeting.

Prof. Gene Zirkel spoke on Multiple Base Number Systems (MBNS).

Capt. Brian Ditter presented An Expansion of Pythagorean Triplets to Ditterian Triads.

Prof. Jay Schiffman spoke on Twin Primes.

Board Meeting Minutes

Annual Meeting of the Dozenal Society of America was called to order around 4:10 PM. Note: Michael asked that Mr. Zirkel preside.

1. Roll Call and Attendance were taken.
2. The minutes of the previous Membership Meeting were postponed until publication of the next Bulletin
3. Treasurer's Report. DSA received a thoughtful bequest from DSA member Ian Patten who lived in Anchorage, Alaska. Ian strongly supported the DSA. Our sincere thanks to Ian Patten and his family for their generosity and support.

DSA needs to change banks due to a number of factors which result in too many fees. We authorize Jay to investigate 2-3 banks in his area and submit suggestions via email at his soonest convenience.

The Treasurer's Report was presented. DSA is now over the $40,000 mark thanks for the most part to the thoughtful bequest of Ian Patten.

After some discussion of investments, The Treasurer's Report was unanimously accepted.

4. Board Appointed Committees.
   Meeting Committee: Gene Zirkel, Michael DeVlieger, and Jay Schiffman
   Finance Committee: Michael DeVlieger and John Impagliazzo
   Outreach/Education Committee: Jen Seron
   Awards Committee: Michael DeVlieger (Chair), Gene Zirkel, and Brian Ditter
5. Election of Officers. Proposed slate of officers: *Asterisk (*) Indicates Incumbents*:
   Board Chair Jay Schiffman*,
   President Don Goodman III,
   Vice President Graham Steele*,
   Treasurer Jay Schiffman*,
   Secretary Jen Seron*.
   The Secretary cast one vote for the slate.
6. Other Board Appointments.
   Michael was reappointed Editor of our *Bulletin*.
   Gene Zirkel was appointed Parliamentarian to the Board Chair by Jay Schiffman
7. The Board Meeting was adjourned unanimously at 4:30 PM.

Membership Meeting Minutes

8. Membership Meeting.

A. Election of Board Members. A slate of 4 Board Members for 3 year terms as the Class of 11ƐX; (2014.) consisting of ten people (versus a dozen) on the Board.

1. Class of 11ƐƐ; (2015.) *Asterisk (*) Indicates incumbents:*

   Jay Schiffman* · Dan Simon

   As there were no other nominations, the vote was unanimous.

2. Nominating Committee:

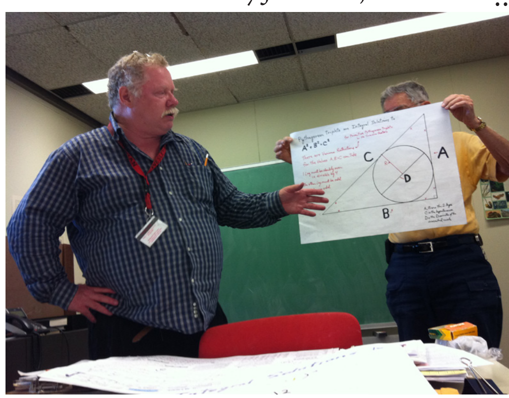
   Gene Zirkel (Chair) · Michael DeVlieger · Brian Ditter

B. Reports for Membership.

1. New Business: John suggested that to expand our base we piggyback our conference at same time and place as a larger related conference.
2. Awards Committee: look for significant people within or outside of the DSA who should be considered. Try to generate press for base-twelve via awards.
3. The next Annual Meetings of the DSA were tentatively set for Atlanta, GA in June, 11Ɛ9; (2013.)

9. Motion to close the Annual Meeting of the DSA was unanimous and the meeting was adjourned unanimously at 4:55 pm.

Submitted by Jen Seron, Secretary



Member Brian Ditter presenting Pythagorean triplets and their extension to Ditterian triads. Gene Zirkel is holding up Brian's chart. Brian's presentation was the second of three that took place ahead of the Meetings.

Dinner at Puglia's City Cafe on Stewart Avenue near the Nassau Community College campus. Proceeding around the table clockwise from left, Brian and his girlfriend Tara, Dr. and Prof. Zirkel, Jen Seron, Claire De Vlieger, and Dr. Impagliazzo appear in this photo.

minutes BOARD & MEMBERSHIP 19; JUNE 11Ɛ9;

19; (21.) June 11Ɛ9; (2013.)
Courtyard Marriot Downtown
Atlanta, GA

Board Chair Jay Schiffman, President Don Goodman III, Board Members Gene Zirkel, John Impagliazzo, Secretary Jen Seron, DSA Members Dan Simon, Mike De Vlieger (by phone part of the meeting).

Board Meeting Minutes

Presiding at DSA Annual Board of Directors meeting: DSA President Don Goodman. Call to order around 1:50 PM by Jay Schiffman

1. Roll Call and Attendance

2. Minutes: Approval of 2011. (Annual Meeting), 2012. (Annual Meeting), and 2013. (phone call) DSA Minutes from annual meetings and phone call.

Gene proposed that the minutes be approved. Jay seconded. All approved minutes as emailed prior to meeting.

3. Report of the Awards Committee: Don presented Jen Seron, DSA Secretary, with the Ralph Beard Memorial Award of the Dozenal Society of America. Jen was flabbergasted, in a nice way. [*Editor's Note:* see facing page for the text of the award.]

4. Election of Officers: Proposed Slate:

Board Chair Jay Schiffman
President Donald Goodman III
Vice President Graham Steele
Treasurer Jay Schiffman
Secretary Jen Seron

Don made the motion to approve. John seconded. Motion passed unanimously.

5. Board Appointments:

Editor of the *Bulletin*: Michael De Vlieger
Parlimentarian: Gene Zirkel

Don moved to approve. John seconded. Motion passed unanimously.

6. Other Committee Appointments:

Meeting Committee: Gene Zirkel, Michael DeVlieger, Jay Schiffman
Finance Committee: Michael De Vlieger, John Impaglizzo
Outreach/Education Committee: Jen Seron
Awards Committee: Michael De Vlieger (Chair), Gene Zirkel, Brian Ditter

Gene moved that the awards committee consist of Michael De Vlieger and Gene Zirkel. Seconded by Jen. Motion carried unanimously.

7. New Business

A. Tiered Dues: Don moves that we have an amnesty on dues until further notice effective January 1, 2014. (ie. dues fee as $0 on the form).

Include a "blank" for donation ex. $ ________

Include a "blank" for "subscriptions" for a paper copy of the *Bulletin* (a dozen dollars until further notice)

Add committee & board membership check-boxes to the membership form

If anyone raises an issue the President has the right to solve this in any way he deems fair.

John moves that we approve this. Don seconded. Motion passed unanimously.

B. Proposed Publication of an anniversary compendium of *Bulletin* articles in one volume. We discussed publishing a compendium of articles and other info on the anniversary six dozenth year of our existence (DSA originated in 1944). Don is editor. Don will cull through issues to pick articles. John will proof. Committee: John, Don, Gene, Jen will consider bids. Final editing done by Don with Don having final editing decisions. Don proposes that we put out a bid for people to do the work. Gene seconded it. Motion passed unanimously.

C. Jen gave out DSA business cards which she had had printed.

8. Adjournment and Break. John moved we adjourn. Gene seconded it. Motion passed unanimously at 7;50 duors (2:50 PM).

Membership Meeting Minutes

Presiding at DSA Annual Board of Directors meeting: Call to order by Jay Schiffman at about 7;76 duors (3:15 PM).

1. Roll Call and Attendance: Gene Zirkel
2. Reading of Minutes (Jen Seron, Secretary)

Gene made motion to accept minutes. Don seconded it. Motion accepted unanimously.

3. President's Report (Don Goodman, President). DSA is showing up higher in Google results for both duodecimal and dozenal. Many are using the DSA calculator which can be downloaded. Many are searching for an online dozenal calculator. We do not have an online calculator. The calculator would have to be rewritten in a web language. We also are getting lots of spam. DSA members are not using login feature: only 12 have used the login feature. To login, DSA members should register online and get a login in order to get their membership number and read minutes. Minutes are not public. Gene made motion to accept the report. Jay seconded it. Motion accepted unanimously.

Continued on page 21;

The Ralph Beard Memorial Award
of the
Dozenal Society of America
is hereby presented to

Jen Seron

Board Member & Secretary

in recognition of her time & effort as Secretary and Board Member, and
in particular for the wonderful job of arranging of our Society's presentation of

Alternate Base Systems for Cross-Curriculum Fun & Engineering Applications

at the ASEE K-12 Workshop on Engineering Education.

We especially appreciate her encouraging and fostering the membership of her young son, Dan, who has not only taken an active part in our Annual Meetings, but has given all of us new hope for the spread of Dozenals in the years ahead.

The members of our Society and the Board of Directors are pleased to present her with this small token of our gratitude and our appreciation.

11Ɛ9; 2013.

Continued from page 20; ⁓

4. Treasurer's Report (Jay Schiffman, Treasurer): in the last couple of weeks Erick Coulter, who a couple DSA members met, who is from Schaumburg, IL gave DSA a $20 donation and $20 dues.

DSA has three accounts: Checking, "Investment" (please change in future to Savings), and American Accounts Investments. We initially invested $5,000 about 10. years ago, as of last year (7/27/2012) our balance was $40,254.54 and now our net balance as of 6/21/2013 is $41,880.16. "I think that we are doing reasonably well and I'm trying to balance things."—Jay.

Gene made motion to accept the Treasurer's Report. Jen seconded it. Motion accepted unanimously.

5. Editor's Report (Mike De Vlieger, Editor): Will put out *Bulletin* soon! Jen made motion to accept the Editor's Report. Seconded by John.

6. Meeting Committee's Report (Gene Zirkel): We should piggyback DSA Annual Meeting in 2014. with the NCTM (National Council of Teachers of Mathematics) in November 2014. We need to fill in a speaker proposal form. List of suggested topics including: number theory, number bases. Lead Speaker's registration fee is free at the Regional Richmond, Virginia or Indianapolis, Indiana NCTM Meetings for 2014. Co-speaker in a panel has to pay $100. including registration for conference. Gene will look into NCTM conferences. NCTM meets on Wednesday, Thursday, and Friday. We could have our DSA Annual Meeting on a Saturday following the NCTM Regional Meeting.

John brought up idea of virtual meetings for DSA Membership and/or Board Members. John said that Adobe has a meeting application: Adobe Connect. They have a rate $30/month. Or we could try "Go to Meeting" on a 30-day trial period. The person running a meeting can post minutes, treasurer's report and then also interact by voice. John will look into the rate for a single one-time meeting. John will compile a list with URLs of around 6 different virtual meeting options (including Skype).

Jen made motion to accept the Meeting Committee Report. Gene seconded it. Motion accepted unanimously.

7. Finance Committee Report (John Impagliazzo, Michael De Vlieger)

Travel to DSA business meetings for DSA Board of Directors should be paid. Travel allowance, hotel, & food allowance per Board Member should be paid like any other organization. Registration fees will be covered for conference participants. Don will submit a proposal to the Board along with Mike. Two hotel nights plus travel plus food. We will have two numbers. Some maximum per person. Some maximum for entire meeting. Guest speakers or invited participants will have honorarium.

Gene made motion to accept the Finance Committee Report. Don seconded it. Motion accepted unanimously.

8. Outreach and Education Committee's Report (Jen Seron)

Jen noted that Don, Jen, and Dan had their proposal accepted and tomorrow morning will be giving a presentation entitled "Alternate Base Systems for Cross-Curricular Fun and Engineering Applications" at the 2013. ASEE (American Society of Engineering Educators) Conference in Atlanta, GA. All agreed that it would be good for DSA to do more education and outreach.

Jay made motion to accept the Education and Outreach Committee Report. Gene seconded it. Motion accepted unanimously.

9. Elections

Election of new Board of Directors. There was a lively discussion about the need for two more board members in order for DSA to have a dozen board members. John made a motion that we approve Pat Zirkel and Catherine Goodman to be nominated for this current term but agreed that at the next Board meeting we will have a discussion of what the size the Board should be in the future. Gene called the question. Motion was accepted unanimously.

Board of Directors, Class of 11ƐƐ; (2015.)

Pat Zirkel · Catherine Goodman

Nominating Committee Report—Board of Directors, Class of 1200; (2016.)

Dr. John Impagliazzo · Prof. Gene Zirkel · Graham Steele · John Earnest

Officers need not be Board members, rather simply Members of the DSA.

Jay made motion to accept the Nominating Committee Report. Gene seconded it. Motion accepted unanimously.

Χ. Dozenal Consensus Numerals (Michael De Vlieger, not present). DSA will discuss this when Michael is present.

Ɛ. Date and location for 11ƐΧ; (2014.) Annual Meeting of the DSA: Gene will look into whether we will meet in 2014 in Indianapolis, IN or in Richmond, VA for our next DSA Annual Meeting.

10. Strategic Planning Discussions: John asked "Why do we exist?". Maybe we could take a more active approach to education and outreach. Jen had idea for a traveling exhibit related to alternate bases and dozenals which would be able to move from museum to museum. Maybe DSA should write an informal science grant. We will think and do further research into ways DSA can actively educate in regard to our stated mission.

11. Adjournment: Motion to close this General Membership Meeting of the DSA was made by Gene and seconded by Don. Motion was accepted unanimously and the 2014 DSA General Membership Meeting meeting was adjourned unanimously at 8;60 duors (5:00 PM).

Submitted by Jen Seron, Secretary

The Practical Dozenalist

Decimal metric, as we know, is flawed mainly because it is based on ten. You can build a "dozenal metric" system with feet and inches, using dozenal fractions for parts of the inch. This is very effective—I'd applied it to field measurements on worksites.

Consider an example. Suppose a room measures 11′-7¾″ and we have walls on either side that have ⅝″ gypsum board on 2×4s (1½″×3½″), and we want to add a 6′-8″ closet on one side. There are a lot of fractions—people are skeered of fractions—so let's use dozenal. The room measures Ɛ7;9″ with ;76″ gypsum board on 3;6″ studs, and we want to add a 68;″ deep closet. Out-to-out, the room measures 2 × [2(;76) + 3;6] + Ɛ7;9. This simplifies to 2 × 4;9 + Ɛ7;9 = 9;6 + Ɛ7;9 = 105;3 inches (12′-5¼″). For the closet, we'll add 68; for the space, and another wall at 4;9, thus 70;9 inches. So the final out-to-out width is 70;9 + 105;3 = 176; inches (19′-6″). Try it in traditional vs. dozenal notation, side by side—which is easier? Makes you think why anyone even considered metric.

Dozenal eliminates the "messy" fractions and facilitates their manipulation, even on the worksite. Try it on your next project! Yes, you can actually *apply* dozenal in your daily life!

Dozenal Integer Sequences

A presentation at the
DSA Annual Meeting by Prof. Jay Schiffman

Professor Schiffman discussed several interesting chains of integers in base twelve. These included the sequences listed below. In these sequences, we give the OEIS (Online Encyclopedia of Integer Sequences) number so that you can look their decimal values up at oeis.org. Many of the following sequences are infinite (some of them are thought to be); only the first dozen terms are given. Some sequences produce large numbers; for these sequences, we include an even smaller sample.

1 3 6 Χ 13 19 24 30 39 47 56 66

TRIANGULAR NUMBERS (OEIS A000217)

1 4 9 14 21 30 41 54 69 84 Χ1 100

SQUARE NUMBERS (OEIS A000290)

1 5 12 26 47 77 Ɛ8 150 1Ɛ9 281 362 462

PYRAMIDAL NUMBERS (OEIS A000330)

1 5 10 1Χ 2Ɛ 43 5Χ 78 99 101 128 156

PENTAGONAL NUMBERS (OEIS A000326)

1 1 2 3 5 8 11 19 2Χ 47 75 100

FIBONACCI NUMBERS (OEIS A000045)

2 1 3 4 7 Ɛ 16 25 3Ɛ 64 Χ3 145

LUCAS NUMBERS (OEIS A000032)

2 3 7 27 157 1407 15,467 207,527

EUCLID NUMBERS (OEIS A006862)

6 24 354 4854 Ɛ,29Ɛ,854 1,7Ɛ8,891,054

PERFECT NUMBERS (OEIS A000396)

Prof. Schiffman examined hexagonal through octagonal numbers and remarked that one could model the series using a “nice closed second-degree polynomial”.

The professor examined primes and remarked that there is no closed formula for computing this irregular series. We could observe that primes “thin out” as we consider ever larger ones. Euclid concluded that the series of primes is infinite.

The Fibonacci sequence is interesting in duodecimal; we see the gross occupying the twelfth term. Schiffman remarked that it is difficult to find two numbers in that series that appear the same in base ten and twelve. Prof. Schiffman invited us to take a look at Fibonacci Quarterly for more on Fibonacci and the similar Lucas sequences.

Professor Schiffman observed some curious patterns in duodecimal integer sequences. Perfect numbers are those that equal the sum of their proper divisors (e.g., 6 = 1 + 2 + 3, thus 6 is perfect). All perfect numbers after the second term end in -54 dozenally.

Each Euclid number after the second term ends in -7 dozenally. The professor explained why we see these patterns when these terms are expressed in base twelve. For the latter, this happens because all terms of the Euclid sequence are one more than a primorial. The primorials are products of the first n primes. The product of the first two primes {2, 3} = 6 is a factor of every subsequent term; each subsequent term introduces primes *p* that are coprime to twelve. Thus, each subsequent term is congruent to 6 (mod 12), thus ends in a 6 in base 12. Since the Euclid sequence is 1 greater than the primorial, each number after the second term will end in 7 in base twelve.

Professor Schiffman wrote a *Mathematica* notebook that enables him to examine dozens of terms, trying to find patterns in their end digits in base twelve. There are many simple patterns in base 12 that are more complicated decimally.

The Online Encyclopedia of Integer Sequences is a treasure trove of such sequences—over a quarter million of them—but they are nearly all decimal. We might consider assembling a dozenal encyclopedia of integer sequences. Some of these sequences may have applications in computer science.

Prof. Schiffman's talk featured more information than could be taken down that evening. His tour through integer sequences seen through the lens of duodecimal was an interesting trip for those of us fond of finding patterns in numbers!

Systematic Dozenal Notation

A presentation at the DSA Annual Meeting by President Don Goodman III

Mr. Goodman presented a system featured in this issue of the Duodecimal Bulletin originated by John Kodegadulo that first appeared at the DozensOnline web forum. This system is one of number names that help us "speak dozenal" the way we can talk about decimal numbers in "plain English". As seen in the article "Dozens in Plain English" on page 5, we have the traditional words "dozen," "gross," "great-gross". If we are going to refer to dozenal numbers regularly, we need something more facile, beyond these three simple terms.

In the *Duodecimal Bulletin* for years we used the Do-Gro-Mo system. This system shortened the words "dozen" and "gross" to "do" (pronounced "dough") and "gro", respectively. (The term "mo" derived from the innovated word "meg-gross" rather than "great gross," "meg" being derived from the Greek for "great".) That system featured a method of easily naming negative dozenal powers by simply adding the prefix "e-" to the positive power term, e.g., "edo" (ee-dough) for one dozenth.

Many different systems have been proposed in the past; none have caught on universally. John Kodegadulo spearheaded a joint development process for Systematic Dozenal Notation or SDN, which borrows the number terms used in the IUPAC system used to name newly-discovered chemical elements like ununoctium (element 118). In this system, particles are assembled into number words the same way that digits are assembled into numbers. (See the article starting at page 9 for a full description.)

This system facilitates discussing dozenal numbers, in contrast to the following examples. Instead of pronouncing the current year "one great-gross one gross eleven dozen nine," we can say "one triqua one eleven nine." This is, in fact, simpler than our current system in decimal.

Alternate Base Systems for Cross-Curricular Fun and Engineering Applications

presented at the ASEE Conference by Don Goodman III, written by Jen Seron

The DSA was privileged to be able to to present a workshop at the annual conference of the American Society for Engineering Education (ASEE) in Atlanta, GA, this June.

This was a lengthy and difficult process which involved developing a program proposal for the ASEE conference maintainers; and, when the proposal was accepted, developing the program and the materials necessary to present it. The vast bulk of this work was done by our own Jen Seron, which, along with her other many good deeds for the Society, rightfully earned her the recognition recounted below.

Even after the program was accepted, we were faced with many challenges, not least of which was that the ASEE put us across from a program presented by Dassault Systemes, which was giving away some rather expensive software to those attending their workshop.

Despite this, our workshop attracted a small but engaged group of lower-elementary teachers (mostly K-6). This group learned the basics of alternate bases; some of the more prominent uses of alternate bases (binary, octal, and hexadecimal primarily); and, of course, they learned about a proposed base for human use, dozenal. Board member Dan Simon also spoke about the Mayan base-twenty system and the Babylonian base-sixty system which gave us a goodly portion of our system of temporal and angular measurement.

After thus covering the basics, we were able to treat the participants as if they themselves were members of an elementary classroom. They designed symbols for ten and eleven, with some interesting results, and discussed the design principles which could lead to various symbolic forms. They asked questions about good strategies for teaching bases to students, particularly younger students, and suggested some good strategies of their own. We were also able to discuss the challenges of teaching bases to anyone, particularly the young.

The materials were prepared primarily by board member Dan Simon and Secretary Jen Seron, and are all available on our website: http://www.dozenal.org/drupal/content/educational-materials.

If you happen to be speaking to an educator or anyone who works with students or children who is wondering how to make math interesting, be sure to suggest working with alternative bases, and to refer them to these educational materials. They include material tailored to all pre-collegiate math levels, and will surely be helpful.

All in all, the workshop was an unquestionable success.

Though small, we were able to hand out a significant body of literature and contact information to non-participants, and made many people aware of the subject of alternate bases in general, and dozenal in particular, who would otherwise likely never have heard of it. We made some good contacts and produced some good publicity. Many thanks to Jen Seron for making it possible!

problem *by Gene Zirkel*

Our last printed issue missed stating the new problem, so let's introduce it here!

Fill in the 3 blanks in this Limerick.

Note that ? < ?? < ???, and also that the syllable counts scan correctly. Hints: the rhyme scheme for a limerick is A-A-B-B-A, and the 3 adjectives given in the first line are all singular.

A __?__, A __???__, and A __??__

Plus three times the square root of four

Divided by seven

Plus 40; and 7

Is nine squared, and not a bit more.

problem solution in next issue

Outline of Ten Minute Lecture on Alternate Bases

I. What are bases and number systems?
- A. Unary system—tally marks
- B. Alphabetic systems—letter for number (Hebrew) and no zero—Roman numerals
- C. Mixed-radix (time: seconds, minutes, hours, days, weeks, months)
- D. Place notation—what we all use today

II. Accustomed to decimal; but use other bases regularly.
- A. Non-decimal customary measures.
- B. Time and angle measurement.
- C. Computers (binary, octal, hexadecimal).

III. Some uses for alternative bases.
- A. Binary
  1. Extremely easy arithmetic (just shifting bits)
  2. Occasionally computer use (also shifting bits)
- B. Octal—Unix file permissions
- C. Hexadecimal
  1. Graphic design—screen color codes
  2. Binary frequently encoded in hexadecimal form
- D. Dozenal
  1. Human-scaled base
  2. Easy multiplication tables
  3. High factoribility
  4. Use in measurement (time, angles, etc.)

IV. Use bases to explore number, measurement, quantity

The Lamadrid Base Name System.

Bases 1–10		Bases 11–36			
1	**unary**	11	undecimal	21	unvigesimal
2	**binary**	12	**duodecimal**	22	duovigesimal
3	**ternary**	13	tridecimal	23	trivigesimal
4	**quaternary**	14	tetradecimal	24	tetravigesimal
5	**quinary**	15	pentadecimal	25	pentavigesimal
6	senary	16	**hexadecimal**		…
7	septenary	17	heptadecimal	30	trigesimal
8	**octal** (octonary)	18	octodecimal	32	duotrigesimal
9	nonary	19	enneadecimal	36	hexatrigesimal
10	**decimal**	20	**vigesimal**		…

You've probably learned the names of some bases in school. We know **decimal** is base 10, **hexadecimal** is base 16, **binary** is base 2, and **octal** is base 8. Some other bases have longer and fancier names, mostly from Latin. Base 20 used by the Maya, is called **vigesimal**, while base 60, used by the ancient Mesopotamians, is called **sexagesimal**.

Above is a chart of some names for bases. The names that are in bold are words you would be able to find, perhaps, in a good dictionary. Because there is no standard way of naming bases, this new system attempts to fill in the gaps in a methodical way, following the way the other names were made, to furnish similar names for the other bases.

The Lamadrid system attempts to preserve common base names, extrapolating the classic method to name other bases.

Unlike names for chemical elements or for numbers themselves, bases don't have a common system of names. What would you call base 14? Where would we get the parts necessary to put together such a name? Of course we can always call it "base 14". If we want formal-sounding names like "decimal" for base 10, or "hexadecimal" for base 16, we might try to use the sources of the parts of those names. These sources are Latin and Greek.

Now we don't live in neither ancient Rome nor Greece, so we might not have to do everything those languages do to express a number. We can mix Latin and Greek, too. The English laungauge has been using Latin and Greek words for new inventions and scientific terms for more than a couple centuries. Because of this, many of the word parts from these languages are fairly easy to understand in English. The Greek word-part "tele" and the Latin word part "vision", or the Greek word part "phone" are easy to understand. "Tele" means "far", so any word that has "tele-" has something to do with distance. Television and telephones are devices that communicate pictures and sounds from afar.

We use the Greek word part "hexa" to impart the idea of sixfoldness in English. We know that a hexagon is a six-sided shape. The Latin word "decimal" communicates something to do with ten. When we put these parts together we get "hexadecimal", meaning base 16. So we can use Greek words for the units and Latin for the tens place. We write these "backward," meaning unit first, then decade, because that's how the words like "hexadecimal" are arranged. Latin places the units ahead of the decades.

We don't have to have perfectly-good Latin names (or Greek ones) for number bases, because we aren't trying to make Latin words. We're making new English words that help us talk about number bases. So we don't have to do everything these older languages do to make actual Latin or Greek number names. Some of the other things Latin does with number names would be confusing in English, so we don't do them!

Unit Particles		Decade Particles		Hundred Particles	
1	un-	10	dec-	100	centes-
2	duo-	20	viges-	200	ducentes-
3	tri-	30	triges-	300	trecentes-
4	tetra-	40	quadrages-	400	quadringentes-
5	penta-	50	quinquages-	500	quingentes-
6	hexa-	60	sexages-	600	sescentes-
7	hepta-	70	septuages-	700	septingentes-
8	octo-	80	octoges-	800	octingentes-
9	ennea-	90	nonages-	900	nongentes-

Preserving common base names and extrapolating the classic method to name other bases.

The column of "particles" or parts of words we can use to build a base name appears in the center of this page. Base 10 and below have a different set of names that matches what's in place today: these end in -ary except for "octal". Remember, the goal is not to change the commonly used names. However, above base ten we use a system that puts hundreds first, then units, then decades, followed by "-imal". So base 144 would be called "centotetraquadragesimal". Putting units in front of decades seems awkward, but it preserves the common name "hexadecimal".

Would this system work in languages other that English? It may. Breaking the rules of Latin and Greek may harm the sensibility of this system in other languages. Speakers of other languages might wonder why we don't do everything older languages do, that might seem strange and confusing to them. It would be up to speakers in those other languages to produce their own names of bases; we won't try to control them. In some languages, like Spanish, Italian, and French, speakers might possibly simply use actual Latin base names. This system is designed to work in English.

An intelligent young friend named Fernando Martínez Lamadrid of México suggested the system for names up to base-99; I've continued the system through the thousands. For this reason, this system is called the Lamadrid system of base names.

the mailbag

Mr. Gage Middaugh, wrote:

»Dear Editor,

I was wondering how the dozenal system would work on a 7-segment (8) display calculator, and I came up with some ideas. For dek, a lowercase t (t), from ten in the decimal system, can be easily recognized on a 7-segment display. A couple distinct ideas for el could be something like a U (U) or a capital Pi (Π = Π), from the Greek alphabet. I think of it like taking the number 11 in the decimal system and connecting the number ones from the top or the bottom with a horizontal line. They can be easily represented on the display. Another one for el could simply be the letter L (L). It's the same pronunciation. Other possible characters that could be used on the display are the Greek lowercase lambda, (λ = λ), English letters A, C, F, (ACF) and various orientations of these characters. I've included a labeled picture of how these would appear, and other various symbols. I'm not sure E (E) would be a great character just because calculators usually use that for errors.

[Above] is the lowercase "t" I talked about, and other English letters. The "U" is right here and next to it, the "L".

[At the end are] the capital Pi and lowercase Lambda. Below are other various symbols that seemed distinct.

Gage Middaugh

»Dear Mr. Middaugh,

Seven segment displays tend to be often thought of when considering new numerals. Take a look at the comprehensive symbology overview published in 2009 for similar thoughts. Thanks for your feedback!

Cordially,
Michael De Vlieger, Editor

Mr. Michael Keller, wrote:

»Hello Mr. De Vlieger,

I hope I have the correct person, and that you are the one who compiled the PDF document of multiplication tables in various bases which I found on theDozenal society website. … I have found your tables highly useful in solving cryptarithms (word arithmetic puzzles) in various bases, which are found in the American Cryptogram Assocation's bimonthly magazine *The Cryptogram*.

I am writing an instructional booklet on solving and composing these puzzles, and would like to reference your document as a useful resource in the Bibliography section. Possibly some advocates of the dozenal system would consider these puzzles frivolous, but base-12 is the second most popular base for ACA puzzles (after 10) and solving duodecimal (sorry) cryptarithms is actually a good way to sharpen up one's arithmetic skills.

See <http://www.puzzlelaboratory.com/TripleKey.html> for a sample of my work.

Your document is also useful, of course, for puzzles in other bases which are seen from time to time: 11 is also a popular base, and one sometimes sees 9, 8, 16, 13, and others.

Best wishes,
Michael Keller,
Puzzle Laboratory ::::

Prof. Paul Rapoport, DSA Member №. 230; sent:

»The dozenal clock [web application] I put together at the end of December (2012) has been modified slightly to make it a little more understandable. It's basically the same. It runs upright or rotated with four hands and a variety of numerals for ten and eleven. It deliberately has a conservative appearance. The two boxes telling dozenal and traditional time remain. [You can visit it at] http://www.dozenal.ae-web.ca.

In England, Shaun Ferguson of DSGB wanted to put the clock on the DSGB website. He also wanted 10 at the top, a 20-hour day, Pitman numerals, a special arrangement around the dozenal point, a specific diameter, and ↊-↋ instead of χ-Ɛ in the box for the dozenal time. We did all that and charged only for the developer's time.

If others want to embed one or more of the clocks on a website, let me know.

Paul ::::

Mr. Robert Maxfield, wrote:

»I am doing a research paper about the dozenal system and was wondering if there were any good books or articles about the history of it. Any help is greatly appreciated.

Thanks,
Robert Maxfield ::::

»Dear Mr. Maxfield,

I could recommend a couple books for you, perhaps some of the others I've copied on this list might as well.

Books on the dozenal system are rare. Many of these simply describe the system and its use, rather than delve into the history of the system. The items appear in my consideration of relevance and usefulness to your research. If you are in the St. Louis area you are welcome to access my own library, which has these titles.

Glaser, Dr. Anton, *History of Binary and Other Nondecimal Numeration*, Tomash Publishers, 1971 (ISBN 0-938228-00-5). The 1971 edition was self-published; the 1981 revision is available at http://www.eipiphiny.org/books/history-of-binary.pdf. It is a favorite of mine. This work sets the consideration of dozenal amid the general consideration of nondecimal bases.

The recent Histories of the Dozenal Societies at the *Duodecimal Bulletin*: (Vol. 49; №. 2 and Vol. 4X; №. 1) are valuable accounts of consideration of duodecimal; these extend into the present from the thirties, so perhaps pick up where Mr. Terry left off. Indeed, Mr. Terry's work is perhaps partially represented in the articles. These resources were penned by current senior members of the dozenal societies. These men were in contact with the Founders of the societies.

Terry, George S., *Duodecimal Arithmetic*, Longmans, Green & Co., New York, 1938. See page 2, wherein he describes books on counting by dozens, in chronological order.

Menninger, Karl, *Number Words and Number Symbols: A Cultural History of Numbers*, Dover, New York, 1969 (English Translation). ISBN 0-486-27096-3. Originally *Zahlwort und Ziffer: Eine Kulturgeschlichte der Zahlen*, Vandenhoeck & Ruprecht Publishing Company, Göttingen, Germany, 1957-8. This work explores the development of number in human history. Twelve comes up in discussion of Nordic cultures, in the Great or Long Hundred, the Teutonic use of dozens which extends into the English. The use of pure duodecimal does not occur in great measure in this book, representing a sort of backwater consideration compared to twelve as an auxiliary for decimal or "long hundred" usage.

Ifrah, Georges, *The Universal History of Numbers: from Prehistory to the Invention of the Computer*, John Wiley & Sons, Inc., New York, 2000. ISBN 0-471-39340-1. Some experts eschew Ifrah's work as they think some of his observations are not corroborated by research but are extrapolations. Still I think his work is useful. He has a second volume that takes in the history after the computer (I have not read that work). This work is similar to Mr. Menninger's.

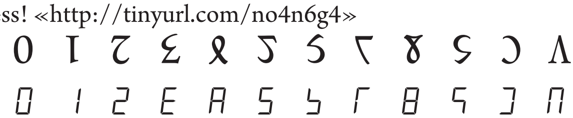
See if these would be of value to your research. I can think of others, but none quite focus on duodecimal vs nondecimal or the history of the dozen system vs its use or application as well as the above. The standard works by Karl Menninger and Georges Ifrah on the history of numbers and counting may be of value. I give these resources in case you'd want to flesh out research; there the context is a stronger signal than what you're looking for, but their observations are valuable and well-known.

Cordially, Michael De Vlieger, Editor

» In my eyes, the key to creating a separate identity system is familiarity.

It's best to use digits that look similar to the ones we use now, that way people won't feel reluctant towards them, and it would also help people to make connections between decimal numbers and their dozenal counterpart.

Attached is my proposal for what these digits should look like, click below to see my thought process! «http://tinyurl.com/no4n6g4»



User Seth M-T at the DozensOnline Forum.

Seth, nice "separate identity" system that is close enough to the current "Hindu Arabic" to be fully transparent! It sort of straddles the gap between the two.

Cordially, Michael De Vlieger, Editor

THE NOMENCLATURE ISSUE

We hope you've enjoyed this issue, focusing on the words we use to name duodecimal numbers. Here are a few questions to ponder! Please send in your thoughts! One of the wonderful things about being a dozenalist is that nothing is set in stone: your thoughts regarding what we ought to call 12^3 are as valid as the ones we've printed here—until the world seriously converts to base twelve and actually begins etching the words into stone!

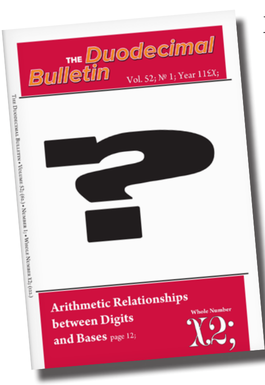
What should we call the numbers zero to one less than one dozen? Do these numerals have to have names different from the ones we use day to day already (i.e., "one", "two"…)

Why can't we simply call "100" in base twelve "one hundred", or 0;1 in base twelve "one tenth?" Wouldn't that make everything easier? Seriously! We wouldn't need to invent names for powers. Would there be other, worse problems with this?

What's wrong with the terms "one gross" and "one great gross"? Can't we just use these plain English words? Why invent a new system of weird words? No one does that in real life, right?

What would you name the dozenal powers of twelve? Would you break your plan into segments of 3 powers, like it is in English (one, ten, hundred, then one thousand, ten thousand, hundred thousand, etc.)? What would be a better way to name powers of twelve?

Preview of the Next Issues



Look for Jay Schiffman's "Patterns and Palatable Morsels Involving Duodecimals" in the next issue, Whole Number X2; (122.)

Joseph Maalouf has written a report that examines the multiplication tables of integer bases less than or equal to twelve. He performs some arithmetic in each base and has a cryptic puzzle at the end for you to solve!

The *Duodecimal Bulletin's* ten dozen third issue will examine divisibility tests. We'll look at handy tests that help us determine whether a number is even, divisible by 3, 4, or 6 just by looking at the last digit. Treisaran's "Split, Promote, Discard" or SPD technique gives us a terrific method of easily determining whether a dozenal integer is divisible by 5 (and by combination with other simple dozenal divisibility tests, X, 13;, 18, 26;, et al.) Several interesting concepts will be introduced in Whole Number X2; that will help us assess the features of various number bases.

The Editor has prepared for the inevitable pelting by eggs and rotten fruit; "Dare I Admit Good Things about Decimal" will run in the coming issues.

Got something awesome you want to share about dozenal? Have you written a paper on dozenals or number bases? Do you use dozenal in your daily life? Please share it with us, we'll check it out and it might be published in the *Bulletin*!

JOIN THE DSA TODAY!

You are invited to join the Dozenal Society of America!
The only requirement is a constructive interest in duodecimals!

Subscription Form (Please print clearly)

Name ______________________________
LAST FIRST MIDDLE

Address ______________________________
STREET

____
CITY STATE/PROVINCE ZIP+4 / POSTAL CODE

____
COUNTRY

Phone ______________________________
HOME WORK CELL

E-Mail ______________________________

Degrees ______________________________

Other Society Memberships ______________________________

Desired Membership Level (Check one)

☐ Regular (free) ☐ Subscription ($12 USD) Donation: __________

A Subscription Membership entitles you to a paper copy of the *Duodecimal Bulletin* when it is published; Regular Members receive only a digital copy. Donations of any amout, large or small, help keep the DSA going and are greatly appreciated.

To facilitate communication, do you grant the DSA permission to furnish your name and contact information to other DSA Members? ☐Yes ☐No

Students please furnish the information below:

School ______________________________

Address ______________________________

Class ______________________________
YEAR MATH CLASS

____
INSTRUCTOR DEPARTMENT

We'd be delighted to see you at our meetings, and are always interested in your thoughts and ideas. Please include your particular duodecimal interests, comments, and suggestions on a separate sheet of paper.

Mail this form and payment to:
The Dozenal Society of America
3627 Forestdale Avenue
Woodbridge, VA 22193

The Dozenal Society of America
5106 Hampton Avenue, Suite 205
Saint Louis, MO 63109-3115

Founded 1160;
(1944.)