DOZENAL SOCIETY OF AMERICA
c/o Math Department
Nassau Community College
Garden City, LI, NY 11530

ISSN 0046-0826

THE DUODECIMAL BULLETIN 57;

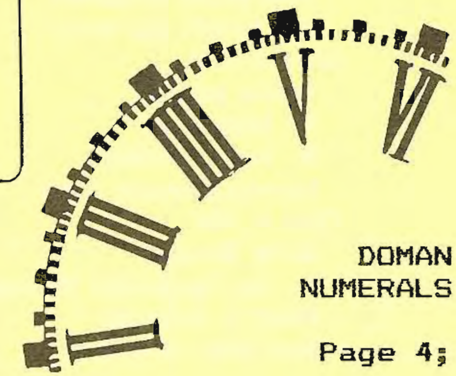
VOTE TO

CHANGE

DSA

CONSTITUTION

Pages 12; - 13;



DOMAN NUMERALS

Page 4;

Volume 30;
Number 2;
Summer 1987
1197;

THE DOZENAL SOCIETY OF AMERICA

(Formerly: The Duodecimal 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 numeration, mathematics, weights and measures, and other branches of pure and applied science.

Membership dues are $12.00 (US) for one calendar year. Student membership is $3.00 per year, and a Life membership is $144.00 (US).

The Duodecimal Bulletin is an official publication of the DOZENAL SOCIETY OF AMERICA, Inc., c/o Math Department, Nassau Community College, Garden City, LI, NY 11530.

The DSA does NOT endorse any particular symbols for the digits ten and eleven. For uniformity in publications we use the asterisk (*) for ten and the octothorpe (#) for eleven. Years ago, as you can see from our seal, we used X and Ɛ. Both * and X are pronounced "dek". The symbols # and Ɛ are pronounced "el".

When it is not clear from the context whether a numeral is a decimal or a dozenal, we use a period as a unit point for base ten and the semi-colon, or Humphrey point, as a unit point for base twelve.

Thus ½ = 0.5 = 0;6.

THE DUODECIMAL BULLETIN

Whole Number Five Dozen Seven

Volume 30; Number 2;

Summer 1197;

FOUNDED 1944

IN THIS ISSUE

Patricia McCormick Zirkel, *Editor*
Editorial Office:
6 Brancatelli Court
West Islip, New York 11795

DOMAN NUMERALS

Gerard Robert Brost
University of Florida, Gainesville, FL

The most important mathematical discovery of the millenium was probably the development of the Hindu-Arabic system of notation. The superior calculability accruing from the discovery of the zero and the place system of value rendered Roman numerals obsolete for purposes of calculation.

However, Roman numerals are not extinct. They are used when multiple systems of notation are needed, as in the numbering of headings and subheadings in complex manuals. They are also used decoratively as on clocks and book chapters.

Unfortunately, decimal-based Roman numerals can be very clumsy in combination with dozenal counting. I have therefore devised a system of dozenal Roman numerals, or "doman" numerals, for use with base twelve counting. The symbols are shown in the accompanying table.

Doman Numerals

1	I	10	I N
2	II	11	I I
3	III	12	I II
4	IIV	13	I III
5	IV	14	I IIV
6	V		
7	VI	20	II N
8	VII	30	III N
9	IIIX	40	IIV N
*	IIX		
#	IX	100	I N N
0	N	1000	I N N N

DOMAN NUMERALS, Continued

The doman symbols for one, two, and three are the same as the Roman symbols, I, II, and III. However, the doman symbol V stands for six, not five. Five in doman numerals is represented as IV, or one less than six. The doman symbol for four is IIV, or two less than six. Seven and eight are written as VI and VII in doman numerals, expressing them in terms of their values above six. Similarly, the numbers nine, dec and el are IIIX, IIX, and IX, defining them in terms of their values less than the dozen.

I have taken the liberty of modernizing the system by adding a symbol for zero, which is the letter "N" for "naught." This provides a means of expressing numbers larger than el within a place system of notation. The dozen is written as I N, or one dozen and no units. Do-one is I I, or one dozen and one unit. Likewise, do-two, do-three, do-four and higher are written as I II, I III, I IIV, etc.

The same conventions apply to larger numbers. For example, one gross (100;) is written as I N N, and one mo (1000;) is written as I N N N. The number 1492 in doman numerals is I IIV IIIX II.

The simplicity of doman numerals makes certain abstract properties of the dozen system easily comprehensible. The terminal digit of any multidigit dozenal number indicates the smallest divisors of that number, no matter how many digits long it is.

> In doman numerals, any number that contains the symbol III in its final digit (i.e., if the final digit is III or IIIX) is divisible by three but not two.
>
> If the final digit contains only two adjacent I's (as in II, IIV, VII, and IIX) the whole number is divisible by two but not three.
>
> If it contains a V along with the II it is also divisible by four. If it does not contain a V along with the II, it is indivisible by four.

Continued . . .

DOMAN NUMERALS, Continued

If the last digit contains a lone "I" (as in I, IV, VI, and IX), it is not divisible by either two or three.

In addition, prime numbers are somewhat conspicuous, because they all contain a lone "I" in their last digit.

If the final digit is V, then the whole number is evenly divisible by two, three, and six.

If the last digit is N, the number is always divisible by two, three, four, six and do.

Seemingly abstract principles of base twelve suddenly become visible when doman numerals are used. How ironic it is that the Romans never discovered this!

IMPOSSIBLE!

The May 1987 issue of the Mathematics Teacher poses this problem:

> If X represents a digit and $X4_5 = 4X_6$, what is the number in base ten?

Of course, the answer, X = 5, and the number (= 29) in base ten, are not correct.

SAME NUMERAL/DIFFERENT NUMBER

Gene Zirkel
Nassau Community College

We are accustomed to representing the same number with different numerals. Thus we write the number eleven as # in base twelve, 11 in base ten, or 1011 in base two. Let us now consider what happens if we interpret the same numeral in different bases. Thus the numeral 101 is five in base two, one hundred and one in base ten, and one gross and one in base twelve.

David Roselle[1] has established the following curious result. Consider the set of 'good' integers defined as follows:

1) 0 and 1 are 'good'

2) an integer > 1 is 'good' if it is NOT the 3rd item of an arithmetic progression of 'good' integers, that is n is not 'good' if there exists x and y such that x and y are 'good' and n - y = y - x (or n = 2y - x).

The set of 'good' integers is {0, 1, 3, 4, 9, *, . . . }.

2 is not 'good' (0, 1, 2 is an arithmetic progression).
5 is not 'good' (1, 3, 5 is an arithmetic progression).
6 is not 'good' (0, 3, 6 is an arithmetic progression).
etc.

The suprising outcome, established by Roselle is that this set of 'good' integers is exactly the same set we get if we interpret all of the non-negative base two numerals as base three numerals:

integers	base two	base three equivalents
0	0	0
1	1	1
2	10	3
3	11	4
4	100	9
.	.	.
.	.	.
.	.	.

Continued . . .

Obviously these are the numbers whose base three numerals do not contain the digit 2. If we let T be the set of Base three numerals which do not contain the digit 2, and G be the set of good numbers, then we wish to show that T = G. To do this we must show that every number in T is also in G and that every number in G is also in T.

First we prove that <u>T is a subset of G</u> :

Clearly for small values of k, for all $n \leq k$, n belongs to T if and only if n belongs to G. Suppose that there exists a number which does not belong to G but does belong to T. Let n be the smallest such number. Then there exist x and y such that x and y are good numbers with $0 \leq x < y$, and x, y, n is an arithmetic progression we will show that, contrary to the above assumption, n is not in T.

First we note that $n - y = y - x$, or $n = 2y - x$.

Since y contains only the digits 0 and 1, it follows that 2y contains only the digits 0 and 2. IF the 0's in 2y are in exactly the same position as the 0's in x and the 2's in 2y are in the same position as the 1's in x, then y would equal x. This is impossible since we know that $y > x$. Consider then, the first digits from the right in 2y and x such that they are not both zero nor are they a 2 and a 1. There are only two possibilities, either a 0 over a 1, or a 2 over a zero. Subtracting gives either

```
   ...0...               ...2...
 -_...1...      or     -_...0...
   ...2...               ...2...
```

Either way, n contains a 2 and hence we have shown that if n does not belong to G then n does not belong to T, that is that T is a subset of G.

See next page . . .

Secondly we prove that <u>G is a subset of T</u> :

The above argument shows that all integers that do not contain the digit 2 are good. Now we must establish the converse: that all integers that contain the digit 2 are not good. Assume the opposite. Suppose at least one good integer contains the digit 2. We now show that this is impossible because it leads to a contradiction.

If any good integer contains a 2, there is a smallest such integer. Let n = this smallest integer. Let y be the integer formed by replacing all the 2's in n by 1's. Let $x = 2y - n$. For example IF n = 1201 then y = 1101 and x = 2(1101) - 1201 = 2202 - 1201 = 1001.

Neither x nor y contains any 2's, hence by the proof above they are both good. Furthermore, $n - y = y - x$ and $0 \leq x < y$. This contradicts our assumption that n was good, and the proof is complete.

Are there any other curious number theoretic properties we can discuss from interpreting the numerals from one base as numerals in a larger base? For example If we interpret the binary numerals as duodecimals we get the dozenals {0; 1; 10; 11; 100; . . . }. Decimally these are {0, 1, 12, 13, 144, . . . }. Again the base three numerals interpreted in base four(i.e., the base four numerals that do not contain the digit 3) are the decimal numbers {0, 1, 2, 4, 5, 6, 8, 9, 10, 16, . . . }. The question open for dicussion is: Do sets such as these have any special properties?

1. "Mathematical Modeling with Spreadsheets" by Diane E. Arganbright, <u>ABACUS</u> , volume 3, number 4, Summer 1986, pages 28-29.

*

BOOK REVIEWS -- *by Jean Kelly*

ELEMENTARY NUMERICAL ANALYSIS, *by W. Allen Smith, A Reston Book published by Prentice-Hall, 1986.*

The parts of this book that readers of this BULLETIN would be interested in are section 1.3, 'Base 2 Representation and Floating-Point Number Systems', and Appendix B, 'Binary-Decimal Representation'.

The book is clear and well written and the author treats well the ideas of base conversion and of round-off errors. He explains how to change a decimal fraction into a binary fraction by doubling the fraction part and retaining the integer. Thus 0.0125 in decimals can be changed to binary by repeatedly doubling the fractional part:

```
integer fraction
        0.125

        0.250
        0.500
        1.0000
        0.0000
          etc.
```

The integers above indicate that decimal 0.125 equals binary 0.0010...

Unfortunately, the author does not generalize this process to every base. Thus we can change fractions to base three by tripling and in general by multiplying by the base.

The exercises include problems in base two, three, five and nine. One question deals with base b, for b = 2 to 9. Several questions are about any base, b. Nothing was said about bases larger than ten or the need for extra digits. However, the answer to one of the exercises was base twelve!

Some of the questions were very thought-provoking and the reader is nicely challenged by them.

BOOK REVIEWS, Continued

Realities of Metrication, A Report

The International Brotherhood of Elected Workers
1125 15 St., NW
Washington D.C. 20005

This 39 page report "was produced by the IBEW for its officers and members with leadership responsibilites in the hope of promoting better understanding of a vital national issue".

It is a very complete analysis of the problem, and it covers topics such as the Metric Conversion Act, common arguments, the effects of metrication on the economy, the consumer taxpayer and worker, and the role of the Federal Government.

The authors have clearly done their homework. This is a document carefully prepared by the people involved in measurement, people who presumably want the best for themselves and their members.

And their conclusion after 30 pages of analysis? They concluded that "The principle arguments for metrication simply cannot withstand objective analysis", and "There is nothing inevitable about metrication . . . The experiences of foreign countries follow a definite pattern and are further proof that metrication is not inevitable but must be forced".

This is a very complete booklet containing much interesting information, and lots of supporting facts and appendices. It is a worthwile acquisition for teachers, libraries and serious students of metrication.

Continued . . .

BOOK REVIEWS, Continued

A Metric America, A Decision Whose Time Has Come.

The National Bureau of Standards

This 169 page book is a report to the United States Congress. It was issued by Daniel V. De Simone, Director of the U.S. Metric Study for the National Bureau of Standards, a Bureau of the U.S. Department of Commerce.

This piece of propaganda gives lip service to words such as 'consensus' and to questions such as 'the best interests of the United States'. However it is clear that NBS is pushing metrics.

The map of the world following the table of contents (pages xii & xiii) would give the impression that the whole world follows the metric system. No mention is made of the fact that their exist almost as many metric systems as there are countries which adopt them. The International Standards Orginization is constantly dealing with this problem.

Although, there is some honesty in listing arguments in favor of our customary units, and even though duodecimals get a mention on page 36, the undercurrent of the book is that we are going to change, we simply have to do so, and the government will have to eventually legislate this change.

We cannot agree with either of the first two ideas, but we do admit that if change ever comes, it will not be voluntary. Just as in every other country in the world, metrics would have to be forced on an unwilling people.

CHEOPS

We have heard that the priests under Cheops, the Egyptian King who built the great pyramid at Giza around 2500 BC, counted in dozens. Can anyone substantiate or debunk this rumor?

DUODECIMAL CONSTANTS

Igor Colonna Valevski, member number #7; of Brazil has been working with mathematical constants and has sent us the values of some of them to four dozen or more places!

For example

Pi = 3;184809 493#91 866457 3*6211 ##1515 51*057 29290*
7809*4 927421 40*60* 55256* 0661*0 3753*3 **5480

e = 2; 875236 069821 9#*719 71009# 388**8 766760 256427
2786## 923#31 032566 054257 348716 7#0

He has also sent us values of pi^2, the square root of pi, the reciprocals of both pi and e as well as the natural logs of 2, 3, 10, and pi, and also the common logs of 2, 3, pi, and e.

We thank him for a job well done. Interested readers may write us for a copy of Igor's results.

The following are available from the Society

1. Our brochure (free)
2. "An Excursion in Numbers" by F. Emerson Andrews. Reprinted from the *Atlantic Monthly*, Oct. 1934. (Free.)
3. *Manual of the Dozen System* by George S. Terry ($1;00)
4. *New Numbers* by F. Emerson Andrews ($10;00)
5. *Douze: Notre Dix Futur* by Jean Essig, in French ($10;00)
6. Dozenal Slide rule, designed by Tom Linton ($3;00)
7. Back issues of the *Duodecimal Bulletin* (as available) 1944 to present ($4;00 each)

CONSTITUTION CHANGE -- PLEASE VOTE!

At the 1986 Annual Meeting of our Society, the members present unanimously indicated that they did not think that the Officers of our Society must be chosen from the Board of Directors. At that time the matter was referred to our Constitution & By-Laws Committee. At the request of that Committee, the Board is now announcing a <u>Special Meeting</u> to be held at Nassau Community College on August 1, 1987. The sole item on the agenda of this meeting is to revise Article III, Section 3 of our Constitution (see below).

As provided by our Constitution & By-Laws, members in good standing may attend and vote <u>by mail</u>. A <u>two-thirds vote</u> of those in attendance is needed to amend the Constitution, so PLEASE CAST YOUR BALLOT.

You can tear off (or xerox) the accompanying ballot and mail it to:

Professor Gene Zirkel
c/o Math Department
Nassau Community College
Garden City, LI, NY 11530

Are your dues paid?

Please let us know if you have a problem concerning dues, or with receiving the <u>Bulletin</u>.

PROPOSAL:

To delete the words appearing below in square brackets from Article III, Section 3 of our Constitution.

> The Board shall elect [from its membership] the Officers of the Society, and may fill [from the voting membership of the Society] any vacancies in the Board until the next Annual election.

[ ] Yes, I vote to change the Constitution.

[ ] No, I vote against the change.

Signed ______________________________________

Date ____________________

Ballots must be <u>received</u> before August 1, 1987.

The 1987 DSA Annual Meeting is October 16 - 18, 1987 at Nassau Community College, Garden City, LI, NY.

Hope to see <u>you</u> there!

FUNNY COINCIDENCE

Bjarke Nielsen
Glostrup, Denmark
December 19, 1986

I just heard that Mr. Eugene Hasenfus has been rescued from Nicaragua, and that reminded me of a story which includes both mathematics and coincidence.

In 1943-44 the Germans tried to win the war by inventing new weapons, for instance, V1 flying bombs and V2 rockets, and they spread rumours that they had some more at hand.

A witty Dane spread this rumour:

> If you want to know the new German weapon, then make this calculation:
>
> > Write a 3-digit number. (First digit must be bigger than the last.)
> > write the digits backwards
> > subtract
> > write the result backwards
> > add
> > Take your telephone-dictionary and find the column with the same number as the result.
> > Find in that Column number CE4563 and on the same line you will see the new German weapon.

The solution is that the result is always 1089, and that in column 1089 is the name Hasenfuss, which in German means hare's foot. I.e., the weapon was that the Germans ran as fast as a hare. Why is it that there was a man with that name in Column 1089: Was it coincidence, or had somebody faked the dictionary?

See next page . . .

PRIME ENDINGS

Mathematicians know that every prime number greater than 3 is of the form 6k $\pm$ 1, where k is a natural number. In base twelve this means that all primes end in either 5, 7, # or 1. Hence we know that:

1) Numbers greater than 3 which end in the other eight digits (0, 2, 3, 4, 6, 8, 9, *) are factorable, and

2) When searching for prime numbers, we need only consider numbers which end in one of the four digits: 5, 7, # or 1.

FUNNY COINCIDENCE, Continued

If you use the same method in dozenals, you will always get the result 10XE. (X=dek; E=elf)

```
Example:    624
          - 426
          -----
            1EX
          + XE1
          -----
           10XE
```

DUODECIMAL TEST (III)

This is the third of four tests which used to be required of all applicants to the DSA. Tests number 1 and 2 appeared in __*Bulletins*__ *number 51; and 54;.*

1. Multiply in duodecimals:

68#4	20 869	941 0*8
x 37*	x # 85*	x #* 987

2. Divide in duodecimals:

1 034 ÷ 8   12 074 ÷ *   97 #16 ÷ 79

639 560 ÷ 4 #39

3. In duodecimals, there are 260° in a circumference. How many degrees apart are the points of a star with 3 points? 4 points? 5; 6; 8; 9; *; 10; 13; 16; 18; 20; 26; 30; 34; 39; 50; 60; 76; *0; 130; points? This multiplicity of factors shows why the Babylonians so divided the circle in the first place.

A sheet of eight conversion rules which originally accompanied Test Four of this series is not in our files. If any of our long-term members has such a list, we would greatly appreciate receiving a copy. Thank you.

DUODECIMAL TEST (III), Continued

4. You have the multiplication tables to 10; x 10; which correspond to the decimal tables of 12 x 12. Write the tables for 11; and 12; which will look very familiar. Perform the following (all in duodecimals), using a single operation in multiplying, and short-division in dividing. Then remember that you are freely using the decimal 13 and 14 tables, which you might otherwise never have thought of learning.

49* x 11=	53 21* ÷ 11=
375 x 11=	
253 x 12=	56 478 ÷ 12=
6*8 x 12=	

5. The sun is distant 27 18# 540; miles from the earth. The duodecimal π = 3;1848 . What is the length of the earth's orbit? (Leave out the fancy astronomy. This is just a matter of multiplication.)

6. If the length of the orbit of Mars is 209 8#9 880; miles, how near can it approach the earth?

7. How many fractional parts of 100_{10} come out even? (Avoid duplications.) How may for the gross? (100;) How would you state their relative factorability?

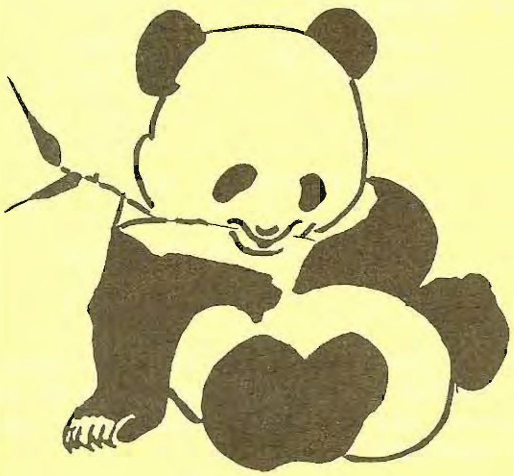
8. If the mile were 1 000; yards, instead of $1,760_{10}$, what would be the reduction: In percentage? In "pergrossage"?

DOZENAL SOCIETY OF AMERICA
ANNUAL MEETING

14; to 16; October 1197;
(October 16 to 18, 1987)

at

NASSAU COMMUNITY COLLEGE
GARDEN CITY, LI, NY



We need you at the Business Meeting!

Your voice is important!

Come and join us:

Let your opinions be heard!

Participate in the presentation and discussion of Dozenal subjects!

Eat, drink and be merry at the Annual Banquet!

Meet interesting people!

Share, Learn and Enjoy!

DOZENAL JOTTINGS

...from members and friends...News of Dozens and Dozenalists...

GENE ZIRKEL (NY), DSA President, recently won a competition sponsored by *Abacus*, a computer publication. Readers had been invited to provide a dialog between an interrogator and an intelligent computer trying to act like a human. This type of game is often called "Turing's Test", after its inventor, Alan M. Turing, who devised the method as an operational test of whether a machine might be said to think. Gene's entry:

Q: What question would you ask if you wanted to differentiate between a person and a machine?

A: What question would you ask if you wanted to differentiate between a person and a machine?

Gene won a two-year subscription to *Abacus*, which he sometimes reads after he has read the *Duodecimal Bulletin*...

Our member number 242; from Hawaii has legally changed his name from **JIUN** to **DEZHON.** Dezhon first learned about duodecimals through his involvment with Esperanto. He wrote to us as follows concerning our math articles and use of symbols:

"I've never liked math -- I just like perfecting the imperfections of life with doing things in better ways. In issue 53; page 23-24, it refers to the DSGB as focussing on 'practical and social aspects' vs. the DSA's 'academic and mathematical exercises'. The math exercises are esoteric mumbo-jumbo to me, but I love the 'practical and social aspects', utopian that I am.

"Finally, a last denunciation of your symbols of * and #, which I hate. They are nothing but confusion. If you write '#4' you are expressing 'number four', because '#' to everybody means 'number' per se, NOT a numeral itself! Isn't that obvious? Newcomers especially could/should be

Continued...

DOZENAL JOTTINGS, Continued

> put off by that...The asterisk is similarly flawed. The connection with the telephone is not good rationale, since in no way does the telephone imply digits, nor place them after 0 (the ten) or before 0 (as twelve)."

Dezhon prefers the inverted "2" and "3" for "dek" and "el". {Editor's note: Dezhon notes that typesetting an inverted 2 and 3 is "no problem". On the contrary, with current methods of photo-offset printing and computer-generated print, this is a very large problem. My own computer will not generate an inverted 2 or 3. Otherwise, these are indeed very fine symbols.}...

ARTHUR WHILLOCK wrote with the sad news that DSGB member **TOM PENDLEBURY** passed away this past Christmas. "His health had been failing for some time and rapidly became worse. He was pleased, and we were fortunate, that he was able to see *T G M* finished and out." An obituary appears on page 3 of the current *Dozenal Journal*, the DSGB publication which was mailed to all DSA members recently...

We also recently learned of the death of **THEODORE BAUMEISTER**, former executive head of the Engineering Department of Columbia University. A member of the Society since 1962, Mr Baumeister was named a Fellow in 1964 and was elected to the Board of Directors in 1968...

In a recent communication, local librarian **LORRAINE KATZ** asked "O.K. - Why the Panda mascot? Because it's everybody's favorite animal -- or does it have twelve toes?" Good thinking, Lorraine! (And a backhanded compliment to our choice of mascot, besides.)...

We also heard from **SKIP SCIFRES** (Denver, CO), **HENRY CHURCHMAN** (Council Bluffs, Iowa), and **THOMAS M. O'NEILL**, (Seattle, WA)...

Continued...

DOZENAL JOTTINGS, Continued

The DSA recently reinstated member number 40; **PAUL ADAMS** (Brooklyn, NY). Unaware of the Society's change of name (from "Duodecimal" to "Dozenal" Society), he wrote to us because he was "pleased to find dozenal ideas still active". We are pleased to have rediscovered an active dozenalist! His main interest is in finding a computer program for calculating in twelve base arithmetic....

Welcome to new members:

Number 2*7; **RAE CHARLES ELTSA** of Lyons, NJ...

Number 2*8; **JAY SCHIFFMAN** from the Math Department of Jersey City State College in Jersey City, NJ...

Number 2*9; **JOSEPH U. ALOHAN** of Brooklyn, NY...

Number 2**; **MATTHEW J. WEITENDORF** of North Olmsted, OH...

Number 140; **H.K. BAUMEISTER.** A new Life Member, Mr. Baumeister joined following the death of his father, Theodore Baumeister, and requested his father's number...

Number 2#0; **ROBERT P. WHITE** of Jersey City, NJ...

Number 2#1; **ARTHUR L. WOERNER** of Huntington, NY. Mr. White and Mr. Woerner both joined at the invitiation of reinstated member number 40; Paul Adams...

...end...

The <u>Bulletin</u> welcomes brief articles on the practical or theoretical uses of number bases, or on the teaching of these.

Why not share <u>your</u> idea with your fellow dozenalists?

PUZZLE CORNER

Answers to game questions appearing in the last issue, pages 23-24;.

TWELVES

1; Epiphany is known as Twelfth Day.
2; The date that "Twelfth Night" was first performed was January 6, 1601.
3; "The Twelve Pound Look" is a play by James Barrie.
4; Gross Dam is in Colorado.
5; The Dozen Islands are in Japan.
6; The Twelvers are a Muslim sect.
7; The Twelve Years' Truce was between Spain, and The Netherlands.
8; The Twelve Bens are mountains in Ireland.
9; One musical system is the twelve tone scale.
*; The Twelve Tribes of Israel are named for the sons of Jacob.
#; The Twelve Patriarchs were the sons of Jacob.
10; Jesus picked one dozen Apostles, and six dozen disciples.
11; The hypoglossal nerve is the twelfth cranial nerve.
12; Economists are concerned with the Gross National Product.
13; Lawyers are concerned with the Gross Negligence Law.
14; Milt Gross was an Amercian cartoonist.
15; The Concordat of Worms was signed in the Twelfth Century.
16; John Biddle, the Father of English Unitarianism, wrote the "Twelve Arguments", denying the Trinity.
17; The Twelve Days of Christmas is a popular Carol.
18; The Capture of Cerebus was the twelfth labor of Hercules.
19; James the Greater and James the Less were two Apostles who shared the same name.
1*; Richard the Lion-Hearted ruled England in the Twelfth Century.
1#; Eugenio Pacelli was also known as Pope Pius XII.
20; Sir Toby Belch is a character in Twelfth Night.

WHY CHANGE?

This same question was probably rife in Europe between the years 1000 and 1500, when the new Hindu-Arabic numerals were slowly making their inching progress in displacing the comfortable and familiar Roman numerals then universally used.

Yet, although it took D years, and despite much opposition—("Who needs a symbol for nothing?")—the new notation did come into popular use. Released from the drag of Roman notation, man's thinking leapt forward dramatically, and mathematicians discovered a new dimension in mathematical symbolism. Working with Hindu-Arabic numeration, they found that the new system better accomodated mathematical statements and facilitated the working out of ideas. Re-examining their fundamental concepts of numbers, they made advances in arithmetic, algebra, logarithms, analytic geometry and calculus, and thus contributed to the explosion of human thought which later became known as the Renaissance.

In a related development, man awoke to the fact that different number bases could be used, and as early as 1585, Simon Stevin stated that the duodecimal base was to be preferred to the base ten.

The parallel seems tenable. The notation of the dozen base better accomodates mathematical statement and facilitates ideation. It, too, is a step forward in numerical symbolism. The factorable base is preferred for the very same advantages which led the carpenter to divide the foot into twelve inches, the baker and the grocer (one who deals in *grosses*) to sell in dozens, the chemist and the jeweler to subdivide the Troy pound into twelve ounces. And yet, this is accomplished by such simple means that students in the primary grades can tell why they are better. Literally, the decimal base is unsatis**FACTOR**y because it has **NOT ENOUGH FACTORS.**

Then should we change? Yes, but no change should be forced, and we urge no mandated change. All the world counts in tens. But people of understanding should learn to use duodecimals to facilitate their thinking, their computations and their measurings. Base twelve should be man's second mathematical language. It should be taught in all the schools. In any operation, that base should be used which is the most advantageous, and best suited to the work involved. We expect that duodecimals will progressively earn their way into general popularity because they simplify the all-important problem of the correlation of weights and measures, the expansion of fractions (1/3 = 0;4) and give an advantage in calculations involving time and our twelve-month calendar. Perhaps by the year 2000, (or maybe by 1200; which is 14; years later!) duodecimals may be the more popular base. But then no change need be made, because people will already be using the more convenient base.

If "playing with numbers" has sometimes fascinated you, if the idea of experimenting with a new number base seems intriguing, if you think you might like to be one of the adventurers along new trails in a science which some have erroneously thought staid and established and without new trails, then whether you are a professor of mathematics of international reputation, or merely an interested pedestrian who can add and subtract, multiply and divide, your membership in the Society may prove mutually profitable, and is most cordially invited.

COUNTING IN DOZENS

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*	#	*10*
one	two	three	four	five	six	seven	eight	nine	dek	el	do

Our common number system is decimal—based on 10. The dozen system uses twelve as the base, which is written *10*, and is called *do*, for dozen. The quantity *one gross* is written *100*, and is called *gro*. *1000* is called *mo*, representing the meg-gross, or great-gross.

In our customary counting, the places in our numbers represent successive powers of ten; that is, in 365, the 5 applies to units, the 6 applies to tens, and the 3 applies to tens-of-tens, or hundreds. Place value is even more important in dozenal counting. For example, *265* represents 5 units, *6* dozen, and *2* dozen-dozen, or gross. This number would be called *2 gro 6 do 5*, and by a coincidence, represents the same quantity normally expressed as 365.

We use a semicolon as a unit point, thus two and one-half is written 2;6.

Place value is the whole key to dozenal arithmetic. Observe the following additions, remembering that we add up to a dozen before carrying one.

94	*136*	Five ft. nine in.	*5;9′*
31	*694*	Three ft. two in.	*3;2′*
96	*3#2*	Two ft. eight in.	*2;8′*
19#	*1000*	Eleven ft. seven in.	*#;7′*

You will not have to learn the dozenal multiplication tables since you already know the 12-times table. Mentally convert the quantities into dozens, and set them down. For example, 7 times 9 is 63, *which is* 5 dozen and 3; so set down *53*. Using this *"which is"* step, you will be able to multiply and divide dozenal numbers without referring to the dozenal multiplication table.

Conversion of small quantities is obvious. By simple inspection, if you are 35 years old, dozenally you are only *2#*, which is two dozen and eleven. For larger numbers, keep dividing by 12, and the successive remainders are the desired dozenal numbers.

```
12 ) 365
 12 ) 30  + 5
  12 ) 2  + 6
       0  + 2   Answer: 265
```

Dozenal numbers may be converted to decimal numbers by setting down the units figure, adding to it 12 times the second figure, plus 12^2 (or 144) times the third figure, plus 12^3 (or 1728) times the fourth figure, and so on as far as needed. Or, to use a method corresponding to the illustration, keep dividing by *, and the successive remainders are the desired decimal number.

Fractions may be similarly converted by using successive multiplications, instead of divisions, by 12 or *.

For more detailed information see *Manual of the Dozen System* ($1;00).

DETACH HERE — OR PHOTOCOPY

We extend an invitation to membership in our society.
dues are only $12 (US) per calendar year; the only requirement is a constructive interest.

Application for Admission to the Dozenal Society of America

Name ______________________ ______________________ ______________________
LAST FIRST MIDDLE

Mailing Address (for DSA items) ______________________

____
(See below for alternate address)

Telephone: Home ______________ Business ______________

Date & Place of Birth ______________________

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Alternate Address (indicate whether home, office, school, other)

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Signed ______________ Date ______________

My interest in duodecimals arose from ______________________

____

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Use space below to indicate special duodecimal interests, comments, and other suggestions, or attach a separate sheet:

Mail to: Dozenal Society of America
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