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

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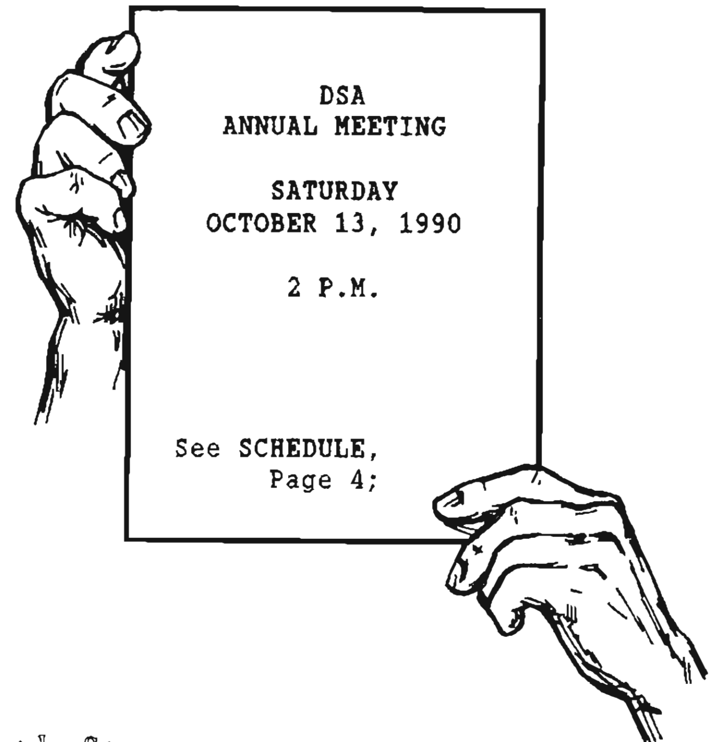
THE DUODECIMAL BULLETIN 66;



Volume 33;
Number 3;
Fall 1990
119*;

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).

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BOARD OF DIRECTORS OF
THE DOZENAL SOCIETY OF AMERICA

THE DUODECIMAL BULLETIN

Whole Number Six Dozen Six

Volume 33; Number 3;

Fall 119;*

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IN THIS ISSUE

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DOZENAL SOCIETY OF AMERICA

SCHEDULE OF THE ANNUAL MEETING -- 119*;

Saturday, October 13, 1990
Nassau Community College
Garden City, LI, NY 11530

2 P.M. *Administrative Tower, Twelfth Floor*

All business at the Annual Meeting is conducted by outgoing officers.

I BOARD OF DIRECTORS MEETING -- Tentative Agenda

1. Call to order, J. Malone, Chair

2. Report of the Nominating Committee (J. Malone, L. Aufiero, A. Catania) and proposal of a slate of DSA Officers:

Board Chair	Gene Zirkel
President	Fred Newhall
Vice President	Alice Berridge
Secretary	Larry Aufiero
Treasurer	Anthony Catania

Continued . . .

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. Whatever symbols are used, the numbers commonly called "ten", "eleven" and "twelve" are pronounced "dek", "el" and "do" in the duodecimal system.

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 1/2 = 0.5 = 0;6.

3. Election of said Officers. The new Officers will be installed later in the day.

4. Appointments to the following DSA Committees:

   Annual Meeting
   Awards
   Finance

5. Other appointments:

   Editor of the *Duodecimal Bulletin*
   Parliamentarian (to the Board Chair)
   Reviewers of articles for the *Bulletin*

6. Other business of the Board

II ANNUAL MEMBERSHIP MEETING -- Tentative Agenda

1. Call to order, F. Newhall, President

2. Minutes of the 1989 Annual Meeting, L. Aufiero

3. President's Report, F. Newhall

4. Treasurer's Report, A. Catania

5. Reports of other Officers and individuals, as called for.

6. Committee Reports:

   Annual Meeting - B. Smith, Chair; L. Aufiero, A. Catania, A. Razziano

   Awards - G. Zirkel, Chair; J. Impagliazzo, J. Malone, A. Scordato, P. Zirkel

Continued . . .

SCHEDULE, 1990 ANNUAL MEETING, Continued

6. Committee Reports (Continued):

Finance - A. Scordato, Chair; L. Aufiero, A. Catania, D. George, J. Malone, A. Razziano, P. Zirkel

Reports of other Committees, as called for.

Continued . . .

Tony Scordato passes the gavel to Fred Newhall at the 1989 DSA Annual Meeting.

SCHEDULE, 1990 ANNUAL MEETING, Continued

7. Report of the Nominating Committee (J. Malone, L. Aufiero, A. Catania):

   a) Nomination and election to the Board of the Class of 1993. The following are proposed:

      Dudley George
      Jamison Handy, Jr.
      Fred Newhall
      Dr. Barbran Smith

   b) Election of a Nominating Committee for the period 1990-1991.

8. New business of the Membership.

III <u>SPEAKERS</u> To be announced

IV <u>DINNER AND EVENING ENTERTAINMENT</u>

To be decided by attendees

End

A NOTE ON THE CHINESE CALENDAR

Igor Valevsky, a Brazilian member, sent us some information regarding the twelve year cycle of the Chinese calendar:

0	Rat	4	Dragon	8	Monkey
1	Ox or Cow	5	Serpent	9	Hen or Cock
2	Tiger	6	Horse	*	Dog
3	Rabbit	7	Sheep	#	Pig

According to Igor, "eleven" is read *Gew-Ju,* and *Ju* also means "pig."

End

Gene Zirkel
Nassau Community College
Garden City, LI, NY

INTRODUCTION

In PART ONE we describe a proposed new set of numerals for use with bases other than ten. These digits are based on the 7-segment calculator display (see figure 3). In PART TWO we examine a pedagogical device for arithmetic based on the intrinsic binary nature of these new symbols. This same idea can be used to design binary calculators or computers for these digits.

PART ONE

An Ongoing Argument

Those who work with various number bases such as base twelve or base sixteen are faced with the problem of what symbols to use for the digits. The two options are:

a) to use the familiar numerals for 0 to 9, and then add other symbols when working in a base greater than ten. For example, computer scientists working in hexadecimals use 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, and F as symbols for the digits from zero to fifteen.[1] Dozenalists in the past used Roman X (dec) for ten and script ℰ (elf) for eleven.[2]

Continued . . .

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DSA
ANNUAL MEETING
Saturday
13 October 1990

2 P.M. --

Business Meeting

Speakers

Dinner

b) create a new set of symbols for ALL of the digits. For example Fred Newhall suggests that

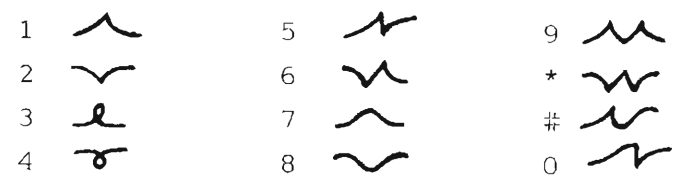

Figure 1

be used for the digits in base twelve.[3] Mohan Kala[4] designed these to be used on a 3 by 3 matrix:

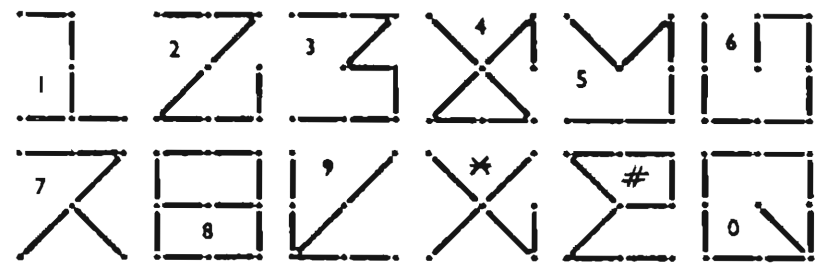

Figure 2

Those who advocate the first approach say that it is too difficult to learn a new set of numerals; that we should build on the familiar, adding as few new symbols as possible.

On the other hand, those who advocate the second approach hold that the ambiguity involved in having a numeral such as 13 represent ten plus three in decimal notation, one dozen plus three in duodecimals, sixteen plus three in hexadecimals, etc. is just too confusing. They maintain that the symbol 13 should represent thirteen and only thirteen.

As an example of notational confusion consider this example. It is common for advocates of the first option to write things such as

$$15_{13} = 13_{15}.$$

Continued . . .

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They think that this notation clarifies the issue. However to the novice it can be very confusing to discover that the numeral 15 on the left is in one base, while the subscript 15 on the right is in another base. (If you don't think that this is confusing, realize that this was taken from an article written in hexadecimals. Thus the 15 on the left is in base nineteen while the 13 on the right is in base twenty-one, and the subscripts are both in base sixteen! The statement says that nineteen + five = twenty-one + three.)

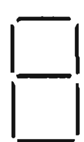
Some writers suggest that binary numerals be written as B'101' and hexadecimals be written as X'3D4'.[5] Many other proposals exist, indicating that notation is indeed a concern of those who deal in the mathematics of various bases. (Cf. for example the suggestion of Tom Linton[6], past president of the Dozenal Society of America.)

In spite of the above, I had always been a member of the former school of thought. One reason for this was that I saw no agreement among the various proposals for new digits, and no reason to select one as better than the others. They all seemed equally mediocre.

However, a recent letter[7] from Bill Schumacher of Cherry Hill, NJ to Dr. Paul Rapoport of McMaster University in Hamilton, Ontario changed my mind. When I first read his idea, I quickly categorized it as one more futile attempt in a seemingly endless procession of proposals for new digits, and put it aside. But, when my wife—who is not a mathematician—remarked about how easy this new proposal seemed, I reread Bill's idea with a more open mind.

One of my objections to previous proposals was how quickly I would forget the new symbols when I wasn't using them. If I came back to an article two weeks after I had read it, I couldn't reread it without relearning the new numerals the author proposed. But Bill's new system contains an inherent logic in the very symbols themselves which indicates what number they stand for. One can make use of this logic when first learning arithmetic. Furthermore, they are designed for display on the familiar 7-segment calculator display.

Figure 3



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Some background

Those who work with number bases are aware of the relationship between a number expressed in hexadecimals and the same number expressed in binary notation. One can convert from one base to the other by simply converting each hexadecimal digit to a four digit binary numeral (and vice versa).

The Hexadecimal Digits and Their 4 bit
Binary Equivalents

0	0000	8	1000
1	0001	9	1001
2	0010	A	1010
3	0011	B	1011
4	0100	C	1100
5	0101	D	1101
6	0110	E	1110
7	0111	F	1111

To change a base sixteen number such as 5A3 to a binary number, simply change each digit to its binary equivalent. Thus

$$5A3_{16} = 0101,1010,0011_2$$

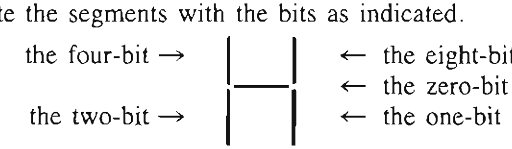
Similarly, to change a binary number such as 11,0110 to hexadecimals, first add zeros to the left so that the number of digits is a multiple of four, and then change each set of four digits to its hexadecimal equivalent. Thus

$$0011,0110_2 = 36_{16}$$

(Similar transformations can be done between bases two and eight, or three and nine, etc.)

It is Bill Schumacher's fortuitous combination of these binary digits (or bits) with the ubiquitous 7-segment calculator display that gives us our proposed new digits.

We associate the segments with the bits as indicated.



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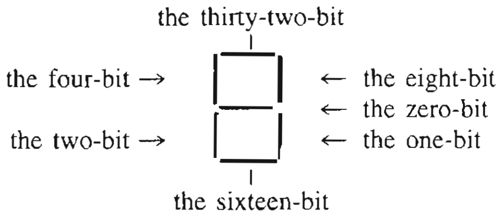
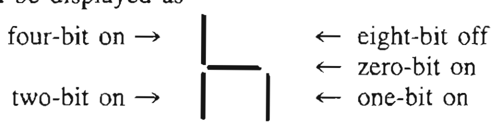
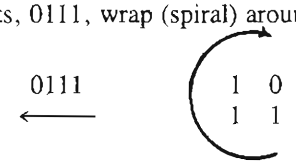
These five segments will be enough for the digits in bases up to base sixteen. If we wish to use these ideas with larger bases, the bottom segment is the sixteen bit, and the top segment is the thirty-two bit. This would be sufficient for bases up to sixty-four.



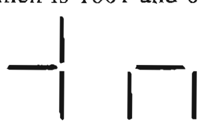
Our new digits are very simply the 7-segment displays resulting from turning on each segment if the corresponding bit is a one, and turning off each segment when the corresponding bit is zero. The horizontal segment representing the zero bit is always turned on. Thus the digit 7 which is represented by the binary bits 0111 would be displayed as



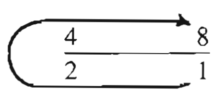
Note the way the four bits, 0111, wrap (spiral) around the 7-segment display.



The two digit number 93, which is 1001 and 0011 in binary digits, would be displayed as



Just remember the segments start with a one in the lower right and proceed clockwise



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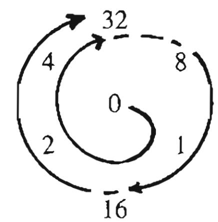
For bases larger than sixteen we have this spiral mnemonic



An Example

In what follows we use base twelve as an example. Similar discussions could be made for other bases. Many authors use the six pointed asterisk (*) for ten and the octothorpe (#) for eleven[8]. These symbols are found on push button telephones with twelve digits and are pronounced "dek" and "el" when counting.

The following chart lists the symbols of our new notation:

Continued . . .

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DIGIT REVERSAL -- *A Puzzle*

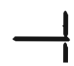
---

11 divides 11 in every base.

12 divides 21 in NO base.

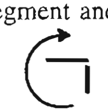
13 divides 31 in base 5.

What about 14, 15, 16, . . ., 1# ?????

decimal	dozenals	binary	7-segment display digits
0	0	0000	
1	1	0001	
2	2	0010	
3	3	0011	
4	4	0100	
5	5	0101	
6	6	0110	
7	7	0111	
8	8	1000	
9	9	1001	
10	*	1010	
11	#	1011	
12	10	0001,0000	

There are several advantages to this notation.

1. The symbols are easy to recall. All one has to remember is that the one-bit is the lower right segment and that they proceed in a clockwise direction.



2. They are obviously adaptable to 7-segment displays on hand held calculators and other similar devices. And they are different from the ten digits and the twenty-six letters currently in use.

Continued . . .

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3. Another advantage is that they are ideally suited to 'physical' adding and 'carrying'. This is useful both as a pedagogic tool when first teaching children how to do arithmetic and also in the designing of circuits for calculators or computers. We develop this idea in Part Two.

Some Illustrations

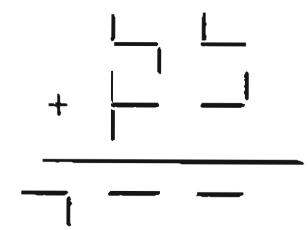
Using base twelve.

Add 54 + 68. Just as we would formerly write

$$\begin{array}{r} 54 \\ +\ 68 \\ \hline 100 \end{array}$$

using ordinary digits in base twelve, so now we write

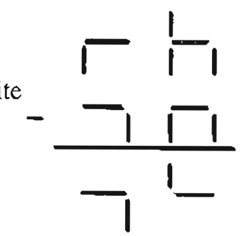
with our new digits.



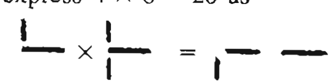
Subtract 27 − 13. Instead of writing

$$\begin{array}{r} 27 \\ -13 \\ \hline 14 \end{array}$$

we write



Multiply 4 × 6. We express 4 × 6 = 20 as



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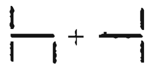
PART TWO

These new symbols contain within themselves a physical interpretation of adding which imitates what you and I do when we *carry*. These ideas can be used for teaching children (and adults) the underlying ideas of arithmetic. If you forget how much

 (7 + 9)

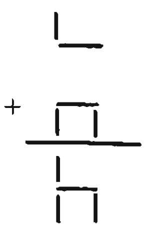
equals, you can easily reconstruct the sum by the principles given below. These same principles could be used to design calculators or computers to add these new digits since they depend on the binary nature of the new symbols.

Arithmetic

Let us examine some arithmetic examples using this new notation. We shall see how we can add the various segments and also how we can *carry* them in a clockwise rotation.

A) Adding With No Carry

Add 4 + 3.



or

```
 0100
+0011
 0111
```

(4 + 3 = 7).

Just add the vertical (i.e., the non-zero) segments. If we were teaching young children we could use blocks for the segments, and the children could physically move the vertical blocks to form the sum.

Note: Those familiar with the concepts of Cuisenaire Rods might want to use blocks such that the block used for the two-bit segment would be twice as long as the block used for the one-bit segment, etc.

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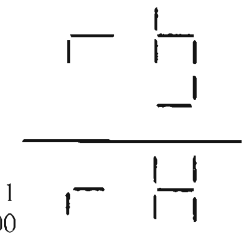
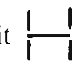
B) Adding With a Dozenal Carry but No Binary Carry (base twelve)

Add 27 + 8.



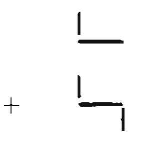
```
  0010,0111
+      1000
  0010,1111
```

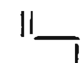
Note that the digit  contains both a four-bit and an eight bit. Although this is valid in base 16, no dozenal digit will contain both these segments. Whenever this occurs (as in the above), we remove them both and carry a one to the one-bit of the next 7-segment digit to the left. Thus the above sum becomes

 (27 + 8 = 33. Here we carry a dozenal one.)

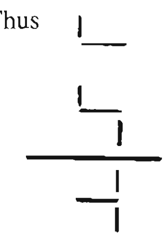
C) Adding With a Binary Carry

Add 4 + 5.



Adding the vertical blocks would give 

Whenever 2 blocks would occupy any bit position we replace them by one block in the *next* clockwise position. Thus  becomes , because 2 four-bits are equivalent to an eight-bit. Thus



(4 + 5 = 9).

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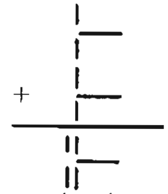
At first one may write down the intermediate step, but it quickly becomes a mental operation, thus to add 6 + 6 we would have



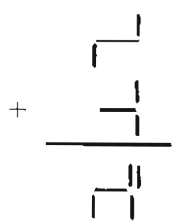
But in our head we add 2 four-bits and write an eight-bit,  , add 2 two-bits and write a four-bit,  . Then seeing that we have both a four-bit and an eight-bit in a digit, we carry one (dozen) to the left obtaining  (6 + 6 = 10).

D) Carrying 2 Eights

Add * + 9.

If we add

we obtain



but instead of carrying 2 eight-bits to a sixteen bit,  , we recall that sixteen is four more than one dozen (one dozen plus four). Hence we replace two eight-bits by one four-bit and we carry one (dozen) to the left, writing

 (or * + 9 = 17).

E) Subtraction and Borrowing

We can 'borrow' bits for subtraction as follows. Subtract * − 4.

Continued . . .

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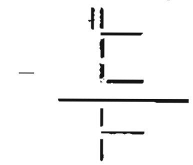
We would like to have a four-bit in the top numeral in order to subtract the four-bit in the bottom numeral from it. Recalling that 2 four-bits equal an eight-bit, we can 'borrow' the eight-bit, replacing it by 2 four-bits. Thus



(* − 4 = 6).

Obviously we would not want people to go through the above every time they added a column of figures. We certainly still expect students to learn addition. These ideas are intended for the understanding of how addition works with our new numerals, and for the design of machine circuits.

Continued . . .

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The content of "Binary Coded Digits" was originally presented as a paper at the 1986 DSA Annual Meeting.

As printed in MATHEMATICS AND COMPUTER EDUCATION, the article ended with the addresses of the DSA and DSGB so that interested persons could write for for information.

Conclusion

Although most computers are strictly binary, a few were made that did arithmetic decimally (They used Binary coded decimals internally.). The digits suggested here are essentially binary coded dozenals (or any other bases that you may prefer). Obviously they could be switched to and from binary for modern calculators and computers. The notation suggested above obviously runs the risk of becoming just one more proposal, but on the other hand it could be that Bill Schumacher's suggestion is an idea whose time has finally come. It certainly has advantages which none of the previous proposals had.

References

[1] G. W. Struble, *Assembler Language Programming,* Addison-Wesley Publishing Co., p. 6 (1975).
[2] F. E. Andrews, "An Excursion In Numbers", *The Atlantic Monthly* 154:4, pp. 459–466 (1934).
[3] F. Newhall, "Efficient Number Symbols", *The Duodecimal Bulletin* 52:2, pp. 14–16 (1985).
[4] S. Ferguson, "The Fondijyal Alpha-Numeric System", *The Dozenal Review* 31, pp. 35–37 (1979).
[5] Struble, p. 119.
[6] "Dozenal Jottings", *The Duodecimal Bulletin* 29:3, p. 25 (1984).
[7] Private communication. Used with permission.
[8] *The Duodecimal Bulletin* 2#:2, p. 2 (1986).

End

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Do you have an idea to share with our members? Why not submit an article to the *Bulletin*?

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

JAMISON and **VERA SHARP HANDY** (CA) travelled extensively this summer, including a conference on public transportation held in Vancouver, BC in June. Jamison is active in a group which seeks to alleviate transportation problems in Los Angeles County. They will also visit New Zealand, and hope to visit dozenalist **BRUCE MOON** in Christchurch, NZ. In addition, Vera's efforts toward music education continue to generate publishing interest. Both sent regrets regarding this Fall's DSA Annual Meeting . . .

We reproduce the following with apologies to **CEDRIC SMITH** (DSGB) . . .

<u>Angry Reader</u>: What's all this about "deer." Do you think I have antlers and 4 legs?????

<u>Us</u>: Pleas do knot miss under stand. We mean that wee love yew and that ewe are very deer to our harts.

You sea, weir imagining watt wood happen if we had won of those brilliant gnu devices, the spelling chequers, witch make sure that the hole of one's spelling is completely write. It looks at each word, won at a thyme, and if it sees a Miss take, it makes annoys two worn ewe. Imagine we have won. Then we try two cheque buy the computer all weave written "hear." All words have past. Nun maid annoys. Their four their a pier's two bee know Miss Steak a tall, oar sew it seams. That's a deaf in it, it's a grate privy ledge two bee awl weighs rite.

<u>Even moor angry reader</u>: Pleas weight. Ewe May bee happy. But eye do know a prove of the weigh you spell. Watt you knead is a bit moor standard eye's Asian. It wood bee much moor easy two reed and under stand watt yew right if yew rote as ewe did bee four, and through those spelling chequers a weigh.

Continued . . .

DOZENAL JOTTINGS, Continued

Us: It seams ewe do knot bee leave that weir getting all hour spelling rite. Have it yore own weigh. But pleas do not come plane if with outcome pewters some Miss takes Creep Inn. . . .

The Newsletter of the International Group on the Relations Between History and Pedagogy of Mathematics reports that DSA member number 28*; **DAVID SINGMASTER** presented a "show and tell" session, a richly illustrated lecture on "Recreational Problems Down the Ages" at the History in Mathematics Education '90 Conference in London . . .

Continued . . .

SOLUTION TO *ROCK - IT*

Issue 65; page 7

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

Charles Ashbacher

End

DOZENAL JOTTINGS, Continued

IAN PATTEN (Anchorage, AK) writes: "In my effort to flesh out (Peter Thomas's) work I dwelt a bit on a navigational system that would tie in with the foot and inch system we presently have, but it wasn't until I came across **HENRY CHURCHMAN**'s Doremic System that I felt we really had a comprehensive navigational system that would stand up for all time. [Ed. note: See the following Bulletins: Vol. #. No. 1. p.1; 10.1.13; 11.2.2#; 12.1.9; 13.1.13; 14.2.3#; 15.1.11.] . . .

Continued . . .

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*, October 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)
8. *TGM: A Coherent Dozenal Metrology* by T. Pendlebury ($1;00)
9. *Modular Counting* by P.D. Thomas ($1;00)
10. *The Modular System* by P.D. Thomas ($1;00)

DOZENAL JOTTINGS, Continued

". . .It struck me that (Henry's) metron should be virtually 11/12 of the 4" hand, and 11/36 of a foot, making (our two) systems inter-related. It would, of course, have been ideal if the 4" hand was reduced by a twelfth to equate the metron, and if the foot made 11 of our present inches so the factors 3 and 4 could be used directly for the tie-in, but perhaps that will come later as people become familiar with dozenal counting and its potential.

"I was wondering about the potential of TGM (TGM: A Coherent Dozenal Metrology Based on Time, Gravity and Mass, compiled by Tom Pendlebury, c.1985 DSGB; and available from the DSA) and also the system by Peter Andrews with a 9.531" foot (See: 13.2.35; 14.2.2#). What is the stance of the DSA on these dozenal metric systems? I noticed that if we ever adopted Pendlebury's 11 5/8" foot this would very conveniently correspond (within thousandths of an inch) to what it would be if we shortened it to comply with a 40" SI meter.

"Something like TGM or Andrews' system would be possible if we were all convinced of their merits, but these would have to be outstanding to convince the public of the radical change in the foot and inch necessary to accommodate them. . ."

Welcome to new member:

308; **DON HILL** Assistant Headmaster
The Mercersburg Academy (PA)

Mr. Hill was enrolled in the DSA by member **CHARLES F. MARSCHNER** (FL), who attended Mercersburg. It was there in the early '30's that his math professor, a Dr. Brown, first acquainted him with decimalized dozens.

End

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 ______

College ______ Degrees ______

Business or Profession ______

Employer (Optional) ______

Annual Dues .... $12.00 (US)

Student (Enter data below) .... $3.00 (US)

Life .... $144.00 (US)

School ______

Address ______

Year & Math Class ______

Instructor ______ Dept. ______

Other Society Memberships ______

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

______

Signed ______ Date ______

My interest in duodecimals arose from ______

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

Mail to: Dozenal Society of America
c/o Math Department
Nassau Community College
Garden City, LI, NY 11530