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

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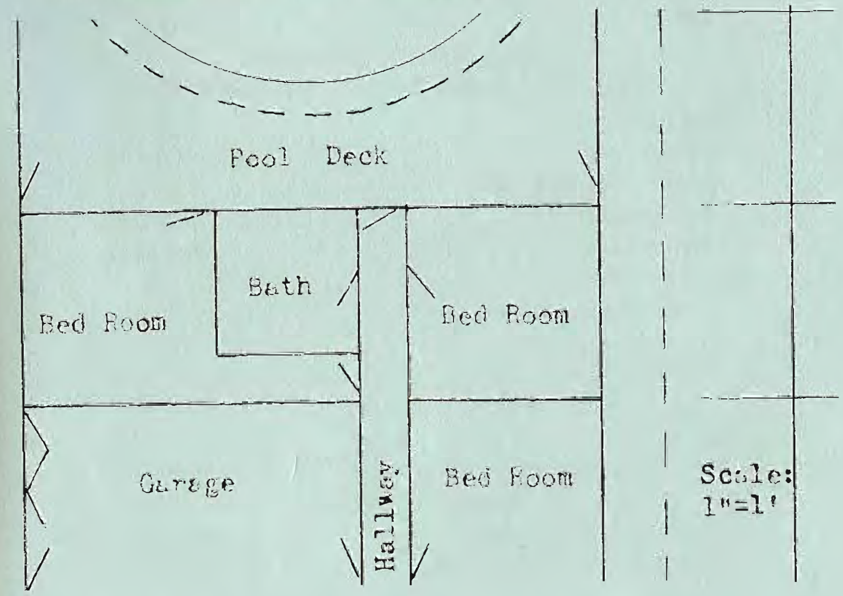
# THE DUODECIMAL BULLETIN

# 4*;

*THE HOUSE OF THE FUTURE?*




*SEE PAGE 16;*

Volume 29;
Number 2;
Summer 1984
1194;

## 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 $9.00 (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 X and * 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 Four Dozen Dek*

*Volume 29; Number 2;*

*Summer 1194;*

## IN THIS ISSUE



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

## PRECISION IN CONVERTING FRACTIONS

*Gene Zirkel*
*Nassau Community College*
*Garden City, NY 11530*

*President Gene Zirkel addressed the following comments on precision in duodecimal fractions to the members present at the DSA Meeting, 15 October, 1983.*

To convert a decimal fraction into a duodecimal fraction is quite easy. One simply multiplies the fraction part by decimal 12 again and again. The integer part of the products yields the next digit of the answer, while the fractional portion provides the next multiplier. This can easily be performed on a hand-held calculator, or simply programmed for a computer.

EXAMPLE: 1/8 = 0.125. Repeated multiplication of the fraction yields:

```
                   0.125
                      12
first digit: 1)     .500
                      12
second digit: 6)    .000
                      12
third digit: 0)     .000
```

Thus we have 0.125 = 0;160

*Continued . . .*

## DSA BY-LAWS

Chairman of the Board, Tony Scordato, reports that his committee has completed their work on a proposed revision of our Society's By-Laws. They will be presented for approval at our Annual Meeting in October.



## *PRECISION IN CONVERTING FRACTIONS, CONTINUED*

ANOTHER EXAMPLE: $\sqrt{3}$ = 1.732 05

```
     0.73205
          12
 8)   .78460
          12
 9)   .41520
          12
 4)   .98240
          12
11)   .78880
          12
 9)   .46560
          12
 5)   .58720
```

Thus we have 1.732 05 = 1;894 #95.

*Continued . . .*

But $\sqrt{3}$ is not exactly 1.732 05. It is only precise to FIVE decimal digits. How precise is $\sqrt{3}$ = 1;894 #95? It so happens that $\sqrt{3}$ = 1;894 #97...

Thus our value for $\sqrt{3}$ = 1;894 #95 is not precise to six places. It is wrong and misleading to imply that it is.

Rounding off to 1;894 #9 is still not precise because $\sqrt{3}$ = 1;894 #* to five place precision. The best that we can obtain from the FIVE place precision in 1.732 05 is the FOUR place value of 1;8950.

PRECISION

When converting a fraction from decimal to duodecimal notation you will in general require less digits to express the same precision. For example, the precision of a decimal fraction expressed with 11; digits is about the same as a dozenal fraction expressed with 10; digits since

$*^{11}$ is approximately equal to $10^{10}$.

A decimal fraction with precision correct to A digits will be expressed in dozenals with only B digits if

$$*^{A} = 10^{B}.$$

Solving the above for B we obtain

$$B = \frac{A \ln *}{\ln 10}$$

In general this yields

$$B < \begin{cases} A-1, & \text{for } 1 < A \leq 11; \\ A-2, & \text{for } 12; \leq A \leq 23; \\ A-3, & \text{for } 24; \leq A \leq 34; \\ \text{etc.} \end{cases}$$

Thus in the example above we have A=5 decimal digits, and hence our answer is precise to about 4 dozenal digits. If we need more than 4 digits we must start with a more precise decimal fraction.



(Note that none of this applies to the first example since 1/8 is exactly equal to 0.125000... and thus has an unlimited number of precise digits.)

As you increase the number of digits in your answer, you also increase the number of multiplications that you must perform. This of course can introduce even more round-off errors, and so you may get less than B precise digits. On the other hand, recall that two place precision in a decimal means an error of at most $\pm$0.005, while two place precision in a dozenal means an error of at most $\pm$0;006. Since this latter is smaller, it tends to give dozenal fractions more precision than decimals.

MORE EXAMPLES:

I $\sqrt{3}$ = 1.732 050 807 568 ...

A = 10;

Therefore B is about # .

But our conversion yields

$\sqrt{3}$ = 1;894 #97 ##9 67# and not

1;894 #97 ##9 687 ...

The best we have is

1;894 #97 ##9 7, with only * precise digits.

II $\sqrt{2}$ = 1.414 213 562 373 with A = 10; yields

$\sqrt{2}$ = 1;4#7 917 0*0 7#7 7 which luckily rounds off to

$\sqrt{2}$ = 1;4#7 917 0*0 7#8 having more than B precise digits.

*Continued...*

III The constants π and e correct to 18; places are:

π = 3.141 592 653 589 793 238 46

e = 2.718 281 828 459 045 235 36

Since A = 18; B is about 16; but our conversions yield:

= 3;184 809 493 #91 866 457 30

e = 2;875 236 069 821 9## 719 6#

The first is precise to 16; places. The second to 17; when we round the 6 up to a 7.

## EXCERPTS

*by Gene Zirkel*

A recent issue of Mathematics And Computer Education, volume 17, number 3, Fall 1983, contained three items of interest.

1) On pp. 233, 234, Jack Skillman solved a problem on rearranging twelve couples at dinner using permutations of a 3 by 4 matrix whose elements were the twelve digits: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, x, y.

2) In "More On Generalized h-base", pp. 216-218, Thomas P. Dence wrote about negative digits. This was reminiscent of the work of our own J. Halcro Johnston, member number 55. Dence's bibliography contains several valuable references.





3) In "A Computer Note on Perfect Numbers", pp. 178-180, David L. Travis points out that when perfect numbers are expressed in base two they are always of the form: p ones followed by (p-1) zeros. If both p and $2^p-1$ are prime then $2^{p-1}(2^p-1)$ is a perfect number. For example:

| p | $2^p-1$ | $2^{p-1}(2^p-1)$ |
|---|---|---|
| 2 | 3 | $6=110_2$ |
| 3 | 7 | $24=11\ 100_2$ |
| 5 | 27 | $354=111\ 110\ 000_2$ |
| 7 | *7 | $4854=1\ 111\ 111\ 000\ 000_2$ |
| # | not prime | - |
| 11 | $2^{11}-1$ | # 29# 854=1 111 111 111 111 000 000 000 000 |
| 65*5 | $2^{65*5}-1$ | (a number with 3754 dozenal digits or 10 #89 bits) |
| #655 | $2^{\#655}-1$ | (a number with 652# dozenal digits or 1# 0*9 bits) |
| 11521 | $2^{11521}-1$ | (a number with 75#0 dozenal digits or 22 *41 bits) |

My typewriter will type 70 digits across an 8;6" by #" sheet of paper. It will type 57 lines. That's 3310 digits with absolutely NO spacing or margins. It would take 2, 2, and 3 sheets of paper respectively to write the last 3 perfect numbers as dozenal numbers, and 4, 8, and 9 sheets of paper respectively to write them in binary notation.

## DOZENAL SOCIETY OF AMERICA

Minutes of the Regional Meeting

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*Friday, January 6, 1984*
*6 Brancatelli Court*
*West Islip, NY 11795*

(1) A winter meeting for the New York region of the DSA was held on the traditional twelfth day of Christmas at the home of Gene and Pat Zirkel.

(2) The meeting was called to order at 9:30 p.m. by President Gene Zirkel.

(3) One dozen persons were present: Members: Gene Zirkel, Patricia McCormick Zirkel, Kathleen McKiernan, Angelo Scordato, John Earnest, John Impagliazzo, Fred Newhall, Victor Gany and George Zirkel (student member). Guests -- Annamaria Impagliazzo, Jean Earnest, and Mary Newhall. Regrets were received from members James and Mary Malone and Alice Berridge.

*(L-R) Annamaria Impagliazzo Kay Mckiernan, Tony Scordato, and Gene Zirkel at the winter regional meeting on the twelfth day of Christmas.*



*REGIONAL MEETING, CONTINUED*

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(4) The report of the Treasurer showed a total asset balance of $16,995.11, as of 31 of December, 1983. This amount is composed of $2195.11 in the checking account, $4550.00 for 70 shares of A.T. and T., and $10,250.00 in a certificate of deposit.

(5) The President reported that membership renewals look encouraging. People are taking advantage of the new dues pre-payment option. There is one new life member -- Charles Bagley. Other memberships are as follows:

| | United States | | Foreign | | Total |
|---|---|---|---|---|---|
| | Regular | Student | Regular | Student | |
| 1983 | 48 | 6 | 10 | 0 | 64 |
| 1984 | 35 | 1 | 5 | 1 | 42 |
| 1985 | 20 | 0 | 3 | 0 | 23 |
| 1986 | 14 | 0 | 1 | 0 | 15 |
| 1987 | 3 | 0 | 1 | 0 | 4 |
| 1988 | 3 | 0 | 0 | 0 | 3 |
| | | | TOTAL PAID MEMBERSHIPS | | 151.00 |

Submitted by

*John Impagliazzo,*
*Secretary*

## COUNTING IN DOZENS -- THE FUTURE IS NOW

Fred Newhall
Smithtown, NY

*Speech presented at the Conference in Mathematics for students of 9th - 12th grades, Nassau County Association of Mathematics Supervisors and Teachers at C.W. POST COLLEGE, Greenvale, L.I. January 10, 1194; two sessions, 17 students total.*

A Futurist is anyone who tries to imagine what the future will be like. Actually we're all futurists; you all like to visualize the "American Dream".

A Practicing Futurist is someone who is impatient for the future to arrive. He wants to enjoy the advantages of the future right this minute. He doesn't want to wait for politicians to drag their feet and only talk about improvements. I think that you students are leaders in your schools; you want to adopt new ideas immediately when you realize they are best.

I'm a Practicing Futurist. Twenty-six years ago I designed and built a "home of the future" with the all the modern improvements incorporated in it including solar energy.[1] At that time few people knew what solar energy design meant. Our family has been enjoying all the advantages of an efficient house ever since without waiting for architects or builders to slowly evolve the conventional shape of houses.

One of the features of this house is its Modular Design. Modular Design means that when laying out the floor plan of a house or building, you start with twelve foot squares as at the edge of my house plan shown here. You'll notice that all the bedrooms are 12 feet by 12 feet, the hallways are an even division of 12 or 4 feet, the doorways are 3 feet wide, bathrooms are 8 by 8'. This means that there is very little waste of materials or time since building materials come in 4' by 8' sheets, and doors are 3' wide. I've made all walls 6 inches wide. It was one of the simplest houses to build.

1. See page 16;





You'll realize there are other appearances of twelve in daily life. There are twelve hours in the day and twelve hours in the night. A year has twelve months because the moon revolves around the earth about twelve times per year. The word month is moon with a th added - moonth. Imagine if we had our calendar with ten months per year; the four seasons would not be an even number of months.

In music there are twelve notes to an octave. This is very confusing since octo means eight; yet there are only seven "conventional notes", do re me fa so la ti, in an octave. These are the white notes on a piano keyboard and with five black notes makes a total of 12 keys in an "octave". The piano should be integrated since all 12 notes are of equal importance. The notes are spaced by the twelfth root of two:

$$\sqrt[12]{2}$$

There are twelve push buttons on your telephone and the old fashioned telephone dial has ten holes with room for two more that could have been added. Someone in Bell Labs knew the advantages of twelve.

The English had twelve pence in a shilling divided into 6 pence and "thrupence" pieces. Did you ever wonder why your pocket is always full of pennies? It takes four of our pennies to make change for a nickle whereas it only takes two pence to make change for a threepence piece.

The Bible mentions twelve tribes of Israel and 12 apostles. We were created with ten fingers, but actually we have only 8 fingers and two thumbs and two palms. Some people in northern Spain have 11 and 12 digits.

In construction a foot is a very convenient unit of measurement. I've often paced off dimensions by placing one foot before another. Lumber comes in feet and inches. A quarter foot is three inches; a third foot is four inches evenly.

*Continued . . .*

A real Futurist has to look into the past to appreciate trends, and mistakes. If you look at the history of numbers you can see that our method of counting has been constantly changing. The Egyptians drew marks in sand, but when they came to eight or nine marks it was hard to tell which was which. When we make marks these days we use the fifth mark to cross off four then later count up the bundles of five. The Phoenicians made hash marks in clay tablets but grouped them. They introduced the idea of starting a second column at higher numbers although their counting was based on 60. The Romans used a V for five and four was one before V; six was one after V, similarly for ten, X, etc. But their system is clumsy for large numbers such as 1983.

We don't realize that the zero was only invented a few hundred years ago. It was needed when we started a second column to fill up the space after the 1 of ten.

The Binary System is used for computers. Plus and minus voltages are represented by 0 and 1, also north and south magnetic charges are applied to tape memory. Sometime in the future a zero voltage and neutral magnetic charge will be used and the Trinary System will provide 50% more memory in the same space. Number systems based on 4, 8, and 16 are also used with computer work.

In electronics we have to know the Color Code alphabet, which you should learn in school because it is quite often useful in later life. Black, a lack of color, is zero; brown is one; the rainbow colors follow; then gray, white, gold, and silver; twelve colors in all. These are used when an electronic component is too tiny for a number. Also we have a set of twelve "Standard values". If you were to try to buy a 50K ohm resistor in a radio store they would not have one; resistors, capacitors and other parts only come in standard values spaced by 10%. There are twelve values in each decade.

The "decimal point" is a very recent invention, in fact it isn't even standardized over the world. Sometimes it's a comma. The so called decimal point can be used in any number base -- for instance, in the Binary System $1\frac{1}{4}$ is 1.01. The





beauty of the metric system is that it introduced the decimal point to replace the many different names like miles, yards, rods, chains, links, etc. But a "Duo-decimal point" can be as convenient in the twelve base of measurement.

Our present base of ten has the handicap that it is not evenly divisible by 3 or 4. One third is 3.3333333333 which is still not exact. One fourth is a decimal .25. In the twelve system one third is .4 and one fourth is .3.

What is the best number base? Consider the factors of each base. In the chart below notice that bases up to ten have only one or two factors. Twelve has four. Of course the larger the base the more factors it's apt to have. If you divide the number of factors into the base you get a decimal. The .33 for the twelve system is 65% better than the ten system. (Proven mathematically)

This advantage shows up very dramatically in the Multiplication Tables for the Duo-Decimal System. If you look at the multiples of three, you'll notice that they all end in 3, 6, 9, or 0 which means that when you see a large number ending in 9, for instance, you'll know it is divisible by three. Similarly multiples of four end in 4, 8, or 0, so that if you have a large number that ends in 8, for instance, you'll know it has a factor of four.

The table is so easy for a young elementary school student to learn that all arithmetic can be learned faster, and I predict that an entire year of mathematics could be cut out of the curriculum if the Duo-Decimal System were adopted.

Many famous people, Napoleon, Walter Raleigh, Sir Isaac Pitman, among others have understood the need for the twelve base of counting. Many books are available through the Intercounty Library System and I'm compiling a 400 page book of conversion tables. The Dozenal Society is engaged in promoting this system; student membership is $3. A membership folder is available.

*See chart, next page.*
*Text continued on p. 15;.*

## COMPARISON OF NUMBER SYSTEMS FOR EFFICIENCY

| Number System | Evenly Divisible by | Number of Factors | Factors Compared to the Size of the Base | Number System |
|---|---|---|---|---|
| 2 | | | | Binary |
| 3 | | | | |
| 4 | 2 | 1 | 1/4=.25 | 4 |
| 5 | | | | |
| 6 | 2,3 | 2 | 2/6=.33 | 6 |
| 7 | | | | |
| 8 | 2,4 | 2 | 2/8=.25 | Octal |
| 9 | 3 | 1 | 1/9=.11 | |
| 10 | 2,5 (present) | 2 | 2/10=.20 | Decimal |
| 11 | | | | |
| 12 | 2,3,4,6 | 4 | 4/12=.33 | Duo-decimal |
| 13 | | | | |
| 14 | 2,7 | 2 | 2/14=.14 | |
| 15 | 3,5 | 2 | 2/15=.13 | |
| 16 | 2,4,8 | 3 | 3/16=.19 | Hexadecimal |
| 17 | | | | |
| 18 | 2,3,6,9 | 4 | 4/18=.22 | 18 |
| 19 | | | | |
| 20 | 2,4,5,10 | 4 | 4/20=.20 | 20 |
| 21 | 3,7 | 2 | 2/21=.09 | |
| 22 | 2,11 | 2 | 2/22=.09 | |
| 23 | | | | |
| 24 | 2,3,4,6,8,12 | 6 | 6/24=.25 | 24 |
| 25 | 5 | 1 | 1/25=.04 | |
| 26 | 2,13 | 2 | 2/26=.08 | |
| 27 | 3,9 | 2 | 2/27=.07 | |
| 28 | 2,4,7,14 | 4 | 4/28=.14 | 28 |
| 29 | | | | |
| 30 | 2,3,5,6,10,15 | 6 | 6/30=.20 | 30 |
| 31 | | | | |
| 32 | 2,4,8,16 | 4 | 4/32=.12 | |
| 33 | 3,11 | 2 | 2/33=.06 | |
| 34 | 2,17 | 2 | 2/34=.06 | |
| 35 | 5,7 | 2 | 2/35=.06 | |
| 36 | 2,3,4,6,9,12,18 | 7 | 7/36=.19 | 36 |



*The fact that every base is divisible by 1 and itself is not worth including in the second column.*

*Notice that the highest efficiency shown in the last column is either the six or the twelve system. Bases as low as six require bulky digits to express larger numbers. Bases above twelve make it difficult to memorize the sequence of numbers, especially backward. So twelve makes the ideal base for an efficient number system.*

*THE FUTURE IS NOW, TEXT CONTINUED FROM P. 13;*

You may find it interesting at home to try some of the elementary arithmetic calculations using the twelve system, to check on how much you really know about basic math.

In this computer age people are learning more and more about the importance of logic. No matter how much you talk to a computer, if you don't follow logic the computer will never function properly. Future generations will rebel at anything that is not as efficient as possible and will realize that adopting the twelve base of counting is essential.

*Questions about counting above 10 were answered. The value of Pi was shown.*

*In answer to "but people won't want to change", my response is that you and I are "people"; we are the people; we have to change first.*

## THE ONCE AND FUTURE DOZENAL HOME

Fred Newhall, member number 279; joined the DSA in 1983 and attended the 1983 Annual Meeting. At that meeting he remarked on several occasions that he had been working with dozens for many years.

One of the most tangible evidences of his ongoing dozenal interest is the home which he built, and in which he and his wife Mary still reside. Located in Smithtown, NY, the home's modern appearance and features belies the fact that it was constructed more than two dozen years ago. The entire plan of the house is based on dozens.

Fred avers that considerable savings in materials and labor can result when houses or buildings are laid out in 12 - foot squares or modules. This "solar" house design (shown on page 17;) has rooms with 12' x 12' dimensions or simple fractions of 12'. Hallways are 3' or 4', the garage is 12' x 20', baths are nominally 8' x 8', and the work room is 8' x 12'. The roof overhangs (solar feature), so is 44' wide. The pool area is 36' round.

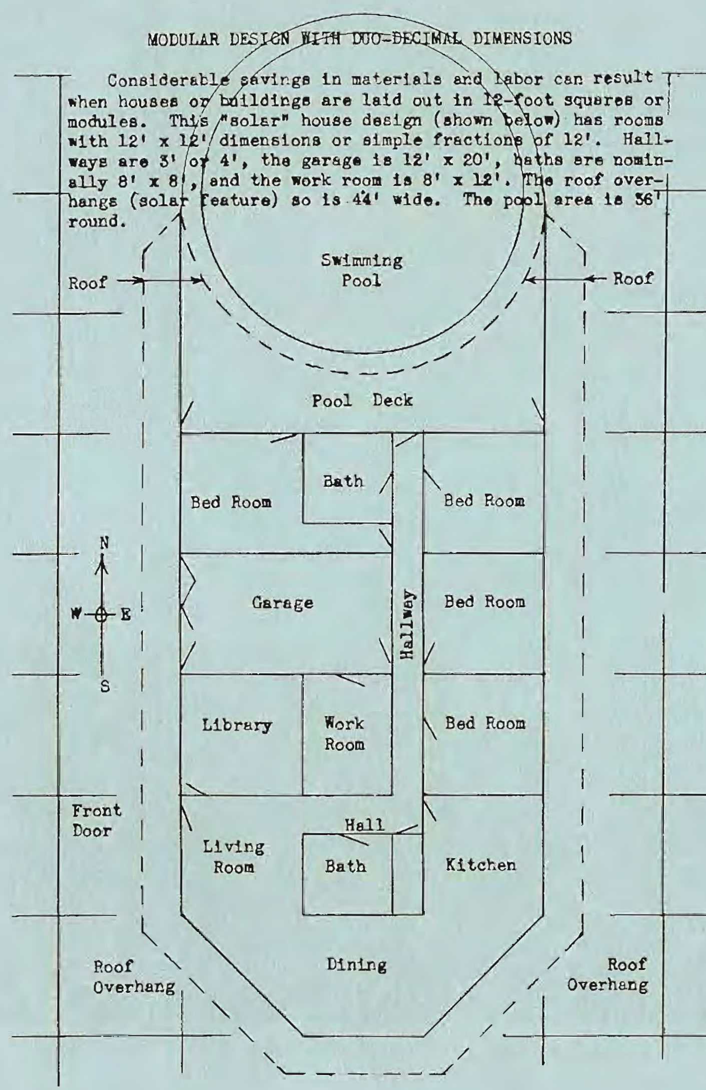
Says Fred: "Although this layout may seem visionary, I designed it 26 years ago, built it myself, and still enjoy the efficiency and comfort of it. The duo-decimal modular design made construction easier and minimized costs, since most building materials come in 4' x 8' sizes."

*The Newhall home in Smithtown, NY, with the azaleas in full bloom.*



*DOZENAL HOME, CONTINUED*

*The chart below has been reduced considerably for reproduction. The original plan is based on a scale of 1' = 10;'. For purposes of comparison, however, the library in the chart below is 10;' x 10;'.*



**WHO WE ARE III:** ANGELO SCORDATO, PH.D.

In 1981 the sudden death of President Tom Linton left our Society with a shortage of able leaders. At the annual meeting later that same year, Dr. Angelo (Tony) Scordato was elected to fill out Tom's unexpired term as a Member of our Board of Directors. The following year our Chairman, Charles S. Bagley, resigned his office after almost two dozen years of service on the Board, and Tony was elected to fill that position. Who is this man who has stepped in to help our Society so swiftly and so capably?

Born in Brooklyn, and residing in Valley Stream, Long Island, Tony has been an avid gardener since childhood, and now raises vegetables and flowers on a 34; foot square plot. When he finishes growing, freezing, and canning the products of his garden, Tony turns to another of his hobbies -- cooking. His specialties are homemade pastas and desserts, and he has lectured on the former to the 4-H Club, of which he has been a member for dek years.

In his spare (?) time he builds clocks and enjoys woodworking. He also enjoys traveling and has been thru Italy, Austria, Spain, France, the Caribbean, Hawaii, and about two thirds of the United States.



*WHO WE ARE, CONTINUED*

Tony received his Doctorate and Professional diploma from the University of Wyoming. He also earned both a BA and an MA from the State University of New York at Albany.

Currently a Professor of Mathematics and Computer Science at Nassau Community College, he has also taught at Queensborough Community College, State University (NY) Agricultural and Technical College-Farmingdale, Adelphi University, St. Pius X Prep Seminary (where he was the Assistant Principal), MacArthur High School, W.C. Mepham High School and Wells Central School.

In addition to his work with the DSA, Tony is also active in the American Mathematical Association of Two Year Colleges, the NY State Mathematics Association of Two Year Colleges, the Association for Computing Machinery, the NY State Association of Two Year Colleges, and the Nassau County Association of Mathematics Supervisors.

Tony has been working diligently since he took office on two major DSA Projects: The updating and revision of our Constitution and of our By-Laws. We are indeed fortunate to have such a man at the head of our Board of Directors.

**THE "YEAR OF THE RAT" BEGINS A TWELVE YEAR CYCLE**

When the Chinese celebrated the beginning of their lunar year 4682 some months ago, they were beginning another twelve year cycle on the Chinese zodiac.

According to legend, the rat was the first animal to reach Buddha when he summoned all the creatures of the world to his deathbed. Thus he is honored first in the zodiac. Following the rat are eleven more honored creatures: the ox, tiger, rabbit, dragon, snake, horse, ram, monkey, rooster, dog and pig.

## DOZENAL JOTTINGS

*News from or about the dozenal activities of members and friends . . . . . . . . . . . . . . . . . .*

Our permanent Dozenal collection now houses all three editions of F. EMERSON ANDREWS' book, New Numbers, thanks to the generosity of his widow. Long a benefactor of our Society, MRS. ANDREWS recently donated a copy of the rare British edition. Almost all of these were destroyed during a World War II bombing raid....ROD GLASGOW, member number 269; is recuperating from a skiing accident and a resultant broken nose. He writes that he prefers the notation $14_{do}$ (or $14_{twelve}$) to GENE ZIRKEL'S D'14' or RITA GILLIGAN'S SU;14 as expressed in Volume 29; number 1;. He states that $14_{do} = 16_{ten} = 10000_{two}$ is simple because it uses language, has no ambiguity and no codes to memorize.....One of our newest members is DAVID SINGMASTER, 28*; of 87 Rodenhurst

*Continued . . .*

## MEMBERSHIP RESPONSE

In an effort to keep our mailing list up to date, all of you received a letter explaining our new dues structure at the beginning of this year. The response has been excellent. Many have renewed membership for more than one year, greatly improving the Society's cash flow.

In addition to dues payments, we also received many letters, and were thus able to catch up on some the activities of our members. (See DOZENAL JOTTINGS, in this issue.) Only two persons resigned membership, and we learned that one has passed away.

If you have not yet responded to the letter that you received, please do so at once, so that there will be no interruption of your subscription. Thanks very much.



## *DOZENAL JOTTINGS, CONTINUED*

Road, London, England. David is the publisher of Cubic Circular, a newsletter for addicts of Rubik's Cube and other puzzles......While sorting through some of RALPH BEARD'S files we recently came across an interesting article by HENRY CHURCHMAN entitled "Our National Debt Reduced to 54,253,475 Dominions?". It was published in the May 1956 Mathematics Teacher XLIX, five, 353-355..... Our appreciation to CHARLES H. BRITTAIN, 119; of Maryland for donating a copy of his Introduction to the Dozenal System to our Dozenal collection. In it he presents his case for the use of twelve entirely new digits instead of

*Continued . . .*

our present system of simply adding dek and el to the well-known Hindu-Arabic numerals.......DSA President, GENE ZIRKEL, Professor of Math and Computer Processing at Nassau Community College in New York, has earned a Master's Degree in Computer Science from N.Y. Tech. He is the first member of his department to have graduate degrees in both Mathematics and Computer Science.......The Duodecimal Bulletin was nicely reviewed by CHARLES W. TRIGG in the Journal of Recreational Mathematics 15:4, 1982-83.... GENE SCIFRIES wrote from Colorado during February saying that he had been spending a great deal of time at home, due to the unfortunate serious illness of his wife. He has been writing computer programs for a company than sells engineering equipment. Skip's then-recent project was a program which would calculate and plot surveying data and calculate the earth volumes that have to be moved when roads are built. Recently he wrote again, saying that he was recuperating from gall bladder surgery. Further computer projects included a program to compute dozenal logarithms. It took a couple of hours to write the program and 5 minutes to run it! This same job, done by Skip in the 1940's took him 3 months...DR. JOHN IMPAGLIAZZO, our new Secretary, taught base twelve along with other bases to his computer science classes. Result: one new student member!...FRED NEWHALL addressed The Long Island (NY) High School Student Symposium at C.W. Post College in January. Shortly afterward, he was invited to speak to a local Masonic luncheon group, whose respose to the word about dozens was enthusiastic....The 1983 DSA Annual Meeting was briefly noted in the December, 1983 issue of the Metric Reporter. The item read in part: Now is the time to investigate the duodecimal metric system....ERICH KOTHE, who authored a three-part article on music in our Bulletins numbered 37, 38, and 39, wrote that he is now working on an article about number bases. We look forward to it..... JAMES A FORSTER, 1*3; of Laurel Highlands H.S. in Uniontown, PA, writes that he will be retiring from his job as of January 1, 1985.....JOHN CHURCHMAN writes that his father, HENRY, continues to maintain an avid interest in current topics and the Dozenal Society. Members and friends can write to this former DSA Board Member and long-time Bulletin editor at the Bethany Lutheran Nursing Home in Council Bluffs, Iowa 51510.......GEORGE CUNNINGHAM, 107; of Orono,





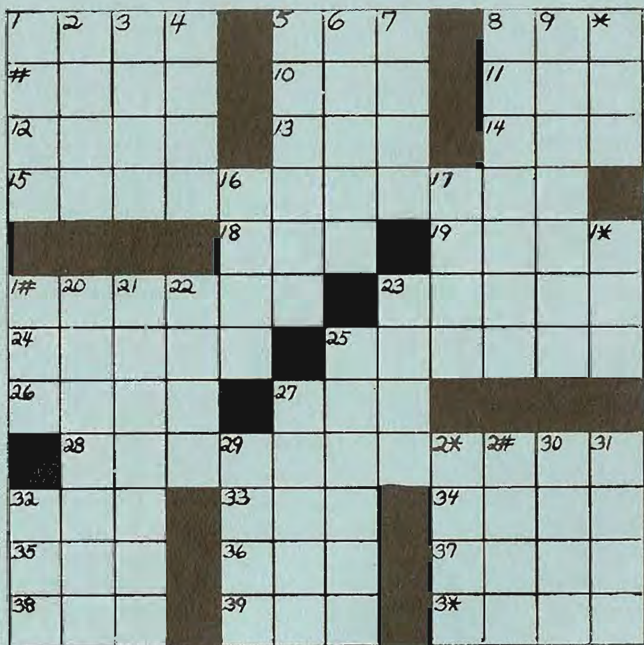
ME, is Vice President of the United States Chess Federation.. PAT ZIRKEL, Editor and GENE ZIRKEL, a Catholic Chaplain at Nassau Community College (NY) have just published an "Haggadah for a Christian Celebration of of Passover", a booklet for Christians who are interested in their Jewish roots....NEELA LAKSHMANAN, 271; is a student at the State U. of NY at Buffalo, JOHN STEELE 246; is a student at the U. of Saskatchewan, and WILLIAN C. MOFFATT, 223; is a student at M.I.T......One of our newest student members is CAROL NORET of Acton, MA. She is finishing fifth grade, and was born in Korea.....A. ADLER HIRSCH writes from Shreveport, LA that a dozenalist does not explode in anger after counting to ten, but does so only after going through dek, el and do!.....VERA SHARP HANDY (wife of JAMISON HANDY) has recently published Little Princess' Symphony Adventures, a complete audio-visual music appreciation course on the instruments of the Symphony Orchestra, for preschool and primary grades......

*end*

*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. (Single copies free. Bulk orders 40¢ each)
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 ($2;00 each)

## PUZZLE CORNER




Our apologies. The PUZZLE CORNER appearing in Vol. 28; No. 3; page 22; had a misprint. The next to last line cannot contain seven "d"s. It should have read:

# = (d/;d -[(d+d)/(d+d)] .

We repeat the corrected version here:

Given the dozenal digit, d, how many numbers can you express with six such digits? For example:

1 = (d+d+d)/(d+d+d)

6 = [(d+d+d)/d ] ! +d-d

# = d/;d - [(d+d)/(d+d)]

11 = d/;$\bar{d}$ + (d/d) + (d/d)



## PUZZLE CORNER

ACROSS

1 Fail to Fail
5 British flyers
8 Do minus dek
# Touched down
10 Aussie bird
11 Sound of surprise
12 New Rochelle college
13 Can, in London
14 Tear
15 Boxing main events?
18 Sis' sib
19 Permits
1# Lunch time?
23 Macho
24 Incantation
25 Chimney piece
26 Stupor
27 Engine need
28 Crapshooter's cry?
32 Curve
33 Seek information
34 Proportion phrase
35 Feel remorse
36 Start for Watson
37 Asian land
38 Math org.
39 Pig's digs
3* Sahara sight

DOWN

1 Receipt word
2 Medicinal plant
3 Washbasin
4 Asterisk
5 April 15 item
6 Kind of acid
7 Ready supply
8 Turbulent stream
9 Kettle sound
* Alley of the comics
16 Old Greek coin
17 Dash
1* Word div.
1# Mil award
20 Kangaroo's kin
21 Avengers
22 King of Norway
23 Bad, to Juan
25 Drugged drink
27 Start
29 Diner sign
2* Clement
2# Biblical twin
30 Harrow's rival
31 Finish second
32 Significant time

*by Rich Silvestri*

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

**IN THE NEXT ISSUE**

*AGENDA FOR THE 1984 ANNUAL MEETING*

*INDEX TO VOLUMES 24; - 29;*

**MISINFORMATION**

Recently, at a garage sale, we came across a copy of National Geographic more than a half dozen years old. One article, "How Soon Will We Measure In Metric", by Weaver and Mackay advocated a ten-based metric system. They say, "..we count by ten, by the decimal system, because ten is the only number that creates multiples of itself by simply changing the first digit." (Emphasis added.) We are accustomed to such erroneous statements in the arguments of uninformed authors who don't check out facts which might interfere with their prejudices, but we really expected better from the editors of a magazine of the stature of the National Geographic. (Vol. 152, No. 2, Aug. 1977)

## 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

*We extend an invitation to membership in our society.*
*Dues are only $9 (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 | $9.00 (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