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

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# THE DUODECIMAL BULLETIN 78;

***IN MEMORIAM***

**JAMISON (JUX) HANDY**

(See page 8;) Jux and Vera Handy at a recent meeting.

Jux and Vera faithfully traveled from California to attend the Annual meetings of the DSA. The next meeting will take place at Nassau Community College, Garden City LI NY on Saturday October 16; (18th) at ∗ AM (10:00). Call 516 669 0273 for details.

*Volume* *3∗;*
*Number* *1;*
*11∗5;*
*(1997)*

# 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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# THE DUODECIMAL BULLETIN


*Whole Number Seven Dozen Eight*

*Volume 3*; (3 Dozen and Dek) Number 1;*

*11*5;*

**FOUNDED**
**11*5; (1944)**


IN THIS ISSUE

# DOZENAL SOCIETY OF AMERICA
# MINUTES OF THE ANNUAL MEETING 11*4 (1996)

*Saturday, October 18; 11*4 (1996)*
*Hosted by UPE Computer Science Honor Society &*
*The Computer Science Club of Hofstra University, Hempstead, NY*

## I FEATURED SPEAKERS

*Attendance:* Prof. Alice Berridge, Dr. Gillian Elston, Michael A. Flach, Dr. John Impagliazzo, Norbert Lis, Prof. Rafael Marino, Alston Mason, Christina Scalise, Prof. Jay L. Schiffman, Jeanette Sones, Prof. Gene Zirkel

The meeting opened at 10:00 AM. Gene Zirkel demonstrated the Dozenal Slide Rule and the group gained facility by working on some problems. He also demonstrated the Dozenal Clock, the design of Paul Rappoport.

1. Professor Gene Zirkel presented a brief history of the Society and discussed how he had become involved with dozens and described the impact the Society has had on his life. Professors Berridge, Impagliazzo, Marino and Schiffman remarked about their involvement with dozenals and with the Society. Some of the students shared their experiences with dozens and other bases. Someone joked that using dozens would "reduce" the National Debt.

2. The group watched the DSA video featuring Professor James Malone. The topic of his talk, "Dozens and Dozens of Eggs" was amusing and instructive to the listeners. Other videos with Dozenal topics are available for loan.

3. President Jay Schiffman of Rowan College, Camden Campus spoke on the topic "Duodecimals are Better." Better because of its four non-trivial factors show 40% efficiency, which he demonstrated. He pointed out that a grocer (derived from the word gross) is an individual who deals in the gross. He noted that twelve is hypercomposite, it has a perfect number of divisors, and is an abundant number. He described the divisibility of twelve and the simplicity of duodecimal fractions and duodecimals.

4. Dr. John Impagliazzo of Hofstra University spoke on the topic "Dits and Dozens." He showed how the computer registers handle binary

*(Continued)*



multiplication and division and demonstrated that the same algorithm, using dits (twelve bits instead of two) would work similarly.

## II BOARD OF DIRECTORS MEETING

1. President Jay Schiffman convened the meeting at 2:45 PM. The following Board members were present: Alice Berridge, John Impagliazzo, Rafael Marino, Jay Schiffman, Gene Zirkel

2. The minutes of the meeting of October 12; 11*3 (10/14/95) were approved as published in The Bulletin.

3. The Nominating Committee (A. Berridge, J. Schiffman, R. Marino) presented the following slate of officers:

| | |
|---|---|
| Board Chair: | Rafael Marino |
| President: | Jay Schiffman |
| Vice President: | Gene Zirkel |
| Secretary: | Christina Scalise |
| Treasurer: | Alice Berridge |

The slate was elected unanimously.

4. Appointments were made to the following DSA Committees:

| | |
|---|---|
| *Annual Meeting Committee:* | Alice Berridge and Gene Zirkel |
| *Awards Committee:* | Gene Zirkel, Patricia Zirkel, Rafael Marino |

Volunteers to these committees are welcome at any time.

5. The following appointments were made:

| | |
|---|---|
| *Editor of The Duodecimal Bulletin:* | Jay Schiffman |
| *Parliamentarian to the Board Chair:* | Dr. Patricia Zirkel |

6. Other Business of the Board:

The Board agreed that because so few copies of New Numbers are available that they will no longer be sold, but will be loaned.

*(Continued)*

The next Board Meeting will be held during the third weekend in October 11*5. Details will appear in the next Bulletin.[1]

The Board Meeting was adjourned at 3:00 PM.

## III ANNUAL MEMBERSHIP MEETING

1. President Jay Schiffman gavelled the meeting to order at 3:00 PM and thanked John Impagliazzo, Hofstra University and the UPE Computer Science Honor Society & The Computer Science Club for their excellent hospitality, accommodations and lunch. Members were enthusiastic about encouraging further collegiate support.

   Efforts will be made to enlist the support of another institution for next year's meeting. Jay thanked members for their help and support.

2. The minutes of the meeting of October 12; 11*3 (10/14/95) were approved as published in *The Bulletin.*

President's Appointment:

*Parliamentarian to the President:* Dr Patricia Zirkel

*Treasurer's Report:* Alice Berridge:

Alice presented the Income Statements for 11*2 (1994) and 11*3 (1995) to compare with the current statement. Because of a decrease in the worth of our stock as well as a decrease in dues income the Society's net worth is now $16,610.99. She reported one new Life Member bringing the total to 26; Life Members. There are seven new Regular Members. Extra Life Members' contributions amounted to $330. Regular Members contributed $144.

In the interest of encouraging increased student interest John Impagliazzo made this motion: Scholarships for Student Members who cannot afford dues will be made available. Such Scholarships must be approved by the Executive Board. Passed.

[1] The next meeting will be held at * AM (10:00 AM ) on Saturday, October 16; 11*5 (10/18/97) at Nassau Community College. For information call 516 669 0273.

*(Continued)*



John also moved that Joint memberships require an extra $3 in dues, and that only one mailing would be made to such Joint members. This was not to be retroactive to include current spouses who had already become joint members. Approved.

It was agreed that the CD, at maturity, will be transferred to a checking account at Fleet Bank. Efforts will be made to see about the wisdom of selling our stocks and investing in mutual funds instead.

*Editor's Report* - Jay Schiffman:

Jay reported that he is pleased with the variety of articles for the Bulletin and is especially pleased with the contribution of poetry. He would like to expand the puzzle and problem section. Members praised Jay for his good work.

*Annual Meeting Committee* - Alice Berridge:

The next annual meeting will take place during the third weekend in October, 11*4 following the meeting of the Board of Directors. Alice and Gene will work together to plan this meeting.[2]

*Awards Committee* - Gene Zirkel:

Members presented a handsome Dozenal clock to Alice for her service to the Society.

*Nominating Committee* - Alice Berridge:

The Committee presented the following slate for the Class of 11*7; (1999):

Charles Ashbacher
Dr.Tony Scordato
Ian Patten
Dr. Patricia Zirkel

The slate was elected unanimously.

Special congratulations were offered to new Board members Ashbacher and Patten.

[2] See previous footnote.

*(Concluded on bottom of page 19)*

# *IN MEMORIAM:* JAMISON HANDY JR.

*Gene Zirkel*

Board Member Jamison (Jux) Handy Jr. of Pacific Palisades, California passed away last year. A retired engineer, and a stalwart of the DSA, he will be sorely missed by all his friends in our Society. We offer our deepest condolences to his family, especially his widow Vera, who is a member of the DSA, and who traveled across the USA along with Jux to attend many of our annual meetings.

The DSA was incorporated in the year 1160; (1944) and held its first meeting in the following year, the year that Jux joined us — becoming our one dozen ninth member. Only two names on our mailing list have lower membership numbers: Life Member, Fellow and former officer Gene Scifres, member number one dozen one, and Life Member Dallas H Lein, number one dozen four.

But it is not merely for his longevity that we honor Jux, for, in addition, he was one of our most active members.

In an early issue of our *Bulletin*, volume 1, number 2, a letter from Jux was published. It presented several of his ideas concerning dozenals and symbols. In fact, in the *Dozenal Index* compiled by Fred Newhall in December 11*2; (1992) Jux is cited in 4½ dozen issues of our *Bulletin*, and most of those citations contain several references. Of course he has been mentioned numerous times since then.

He was elected to our Board of Directors in 1171; (1957), and served over three dozen years in that capacity. Furthermore, in 1177; (1963) he was appointed Editor of this *Bulletin* by the then President Charles S. Bagley at our one dozen seventh annual meeting, held at the Carnegie Endowment International Center in New York City. He served in that position until 1182; (1970), and again as Associate to Editor Henry Churchman when the latter became ill. When for a brief time Henry became too ill to produce the *Bulletin*, Jux jumped in and produced a series of brief newsletters entitled "Dozenal Doings".

Our membership is spread far and wide, and many of us have little contact with one another other than the printed word. Thus, these newsletters were very important in keeping our Society alive until the new Editor, Dr. Patricia McCormick Zirkel appeared on the scene.

For his many contributions Jux was made a Fellow of the DSA and in 1193, (1983) our Society's highest honor — the Annual Award — was bestowed on him. With typical modesty, he listened as Dr. Tony Scordato read out the honoree's specifics.

> "As you know the purpose of our Society is to conduct research and further public interest in dozenal mathematics and its applications. As a Society, we have had

*(Continued on page 9)*



# DITS AND DOZENS
# MULTIPLICATION AND DIVISION USING MACHINES

*John Impagliazzo*
*Hofstra University*

A dit is a dozenal digit. Dits are commonly used to represent numbers in dozens (base twelve). These are 0, 1, 2, ..., 9, *, and #, where * is dek and # is el. For example, the sequence of dits *9*3#* which is read as *nine mo, dek gro, three do, el* can be converted to decimal by

$$9(12^3) + 10(12^2) + 3(12^1) + 11(12^0)$$

Arithmetic operations using dozens are well known. We can add, subtract, multiply, and divide in dozens as readily as with any other base. One feature of dozens is divisibility where the numbers 1, 2, 3, 4, 6, and 12 each divide the number 12 evenly.

In electro-mechanical settings such as the area of computers, numbers are saved or held

*(Continued)*

**In Memoriam: Jamison Handy, Jr.** (Concluded)

> several levels of Inmembership over the years — from aspirant thru senior member to Fellow. However, one special honor has been reserved for those who have contributed in a major way to the literature, application or the enjoyment of the duodecimal system. This is the DSA's Annual Award.
>
> "The Board and Officers of the Society, after due deliberation, have this year selected one of our members for this distinguished honor. This award goes to a man who over many years has contributed to the aims and goals of the Society thru his work on the *Bulletin*, "Dozenal Doings", and in a variety of other activities — Jamison Handy!"

At the mention of "Dozenal Doings" Jux was truly surprised. He later shared that he had assumed that Tony was speaking of me. His award read:

> *The Annual Award of the Dozenal Society of America is given to Jamison Handy Jr. in recognition of his devotion to the Society and to its ideals, and for his service as a Member of the Board of Directors, as Editor of the Duodecimal Bulletin, as Founder and Editor of "Dozenal Doings, And for his many years of active participation in the work of the Society.*
>
> *Presented with Gratitude By the Board of Directors*

□

in buffers called registers. Consider a dozenal machine with each register containing n dits or positions. The lowest order dit is the right most element of the register; the highest order dit is the left most dit of a register. Arbitrary register X would then contain elements

$$\boxed{x_{n-1}\ x_{n-2} \cdots x_2\ x_1\ x_0}$$

where $x_{n-1}$ is the highest order dit and $x_0$ is the lowest order dit.

It is commonly known that calculators and computers cannot multiply or divide numbers. When we do one of these operations, we really are invoking an algorithm to calculate the product or the quotient and remainder. Let's investigate what happens when we do binary (base 2) multiplication where each bit is 0 or 1. Make B an n-bit register. Let registers P and A each be n-bit registers where A is concatenated or adjacent to the right of P. For multiplication, we often extend the higher order part of register P by one position to $p_n$ to account for a carry place value if needed. See Figure 1.

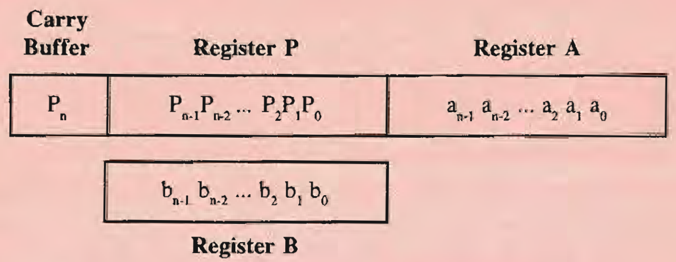


**Figure 1: Operating registers for multiplication and division**

To multiply two unsigned binary integers a and b located in n-bit registers, one algorithm goes as follows.

1. Initialize registers A, B, and P
   $A \leftarrow a,\ B \leftarrow b,\ P \leftarrow 0$
2. If the lowest order bit of register A is 0, add 0 to register P; otherwise add B to register P.
3. Shift each bit in register pair PA one bit to the right.
4. Repeat steps 2-3 (n-1) times

For example, suppose we wish to obtain the product of 5 and 6 using 4-bit registers. We set decimal 5 in register A as binary 0101, decimal 6 in register B as binary 0110, and decimal 0 in register P as binary 0000. The loop of our algorithm proceeds as shown in Figure 2.





| C P A B | |
|---|---|
| 0 0000 0101 0110 | ; initialize |
| | |
| 0 0000 0101 | ; begin loop 1 |
| 0110 | ; $a_0$=1 so add B |
| 0 0110 0101 | ; sum up |
| 0 0011 0010 | ; shift right |
| | |
| 0 0011 0010 | ; begin loop 2 |
| 0000 | ; $a_0$=0 so add 0 |
| 0 0011 0010 | ; sum up |
| 0 0001 1001 | ; shift right |
| | |
| 0 0001 1001 | ; begin loop 3 |
| 0110 | ; $a_0$=1 so add B |
| 0 0111 1001 | ; sum up |
| 0 0011 1100 | ; shift right |
| | |
| 0 0011 1100 | ; begin loop 4 |
| 0000 | ; $a_0$=0 so add 0 |
| 0 0011 1100 | ; sum up |
| 0 0001 1110 | ; shift right |
| 0 0001 1110 | ; halt |

**Figure 2: The product 5 * 6 using 4-bit binary registers**

The binary result 00011110 in concatenated registers PA converts to decimal as 30.

We can divide two unsigned binary numbers a and b located in n-bit registers to obtain the result a/b. One algorithm goes as follows.

1. Initialize registers A, B, and P
   $A \leftarrow a,\ B \leftarrow b,\ P \leftarrow 0$
2. Shift each bit in register pair PA one bit to the left and assume that $a_0$ is temporarily vacant
3. Subtract B from P
4. If the result from #3 is negative, set $a_0$=0 and add B back to P; otherwise set $a_0$=1 and add 0 to P
5. Repeat steps 2-4 (n-1) times

For example, suppose we wish to obtain the quotient and remainder of 14 divided by 3 using 4-bit registers. We set the decimal dividend 14 in register A as bin/ary 1110, the decimal divisor 3 in register B as binary 0011, and decimal 0 in register P as binary 0000. The loop of our algorithm goes as shown in Figure 3.

| P | A | B | |
|---|---|---|---|
| 0000 | 1110 | 0011 | ; initialize |
| | | | |
| 0000 | 1110 | | ; begin loop 1 |
| 0001 | 110? | | ; shift left |
| -0011 | | | ; subtract B from P |
| -0010 | 1100 | | ; result negative, set $a_0=0$ |
| 0011 | | | ; add B to P |
| | | | |
| 0001 | 1100 | | ; begin loop 2 |
| 0011 | 100? | | ; shift left |
| -0011 | | | ; subtract B from P |
| 0000 | 1001 | | ; result not negative, set $a_0=1$ |
| 0000 | | | ; add 0 to P |
| | | | |
| 0000 | 1001 | | ; begin loop 3 |
| 0001 | 001? | | ; shift left |
| -0011 | | | ; subtract B from P |
| -0010 | 0010 | | ; result negative, set $a_0=0$ |
| 0011 | | | ; add B to P |
| | | | |
| 0001 | 0010 | | ; begin loop 4 |
| 0010 | 010? | | ; shift left |
| -0011 | | | ; subtract B from P |
| -0001 | 0100 | | ; result negative, set $a_0=0$ |
| 0011 | | | ; add B to P |
| | | | |
| 0010 | 0100 | | ; halt |

**Figure 3: The quotient 14/3 using 4-bit binary registers**

The binary result is in two parts. The left part P gives the remainder 0010 and the right part A gives the quotient 0100. Here the remainder converts to decimal 2 and the quotient converts to decimal 4 as expected.

What if we have a dozenal computer rather than a binary computer? What happens if the registers contain dits instead of bits? Among other things, a different algorithm is needed to do products and quotients without multiplying or dividing. We can propose an extension of the previous algorithms to include the necessary provisions to obtain the correct results. Initialization is similar as before. For multiplication, A is a n-dit register containing the multiplicand, B is a n-dit register containing the multiplier, and P is a n-dit register containing zeros. For division, A is a n-dit register containing the dividend, B is a n-dit register containing the divisor, and P is a n-dit register containing zeros. As before register A is concatenated to the right of P.

We begin with multiplication. As with binary, the loop must iterate n times to process all

*(Continued)*



the dits in the registers. In binary, the bit $a_0$ could equal 0 or 1. In dozens, the dit $a_0$ could be any value 0, 1, 2, ..., 9, *, or #. This requires adding B to P in an accumulating loop $a_0$ times. The result is then shifted to the right one dit, and the iteration continues. This results in the following algorithm for multiplication of dozenal numbers a and b. The symbol $+_z$ denotes addition in dozens.

1. Initialize registers A, B, and P
   $A \leftarrow a,\ B \leftarrow b,\ P \leftarrow 0$
2. Loop n times steps 3 through 5
3. Loop $a_0$ times steps 3 through 4
4. $P = P +_z B$
5. Shift each dit in register pair PA one dit to the right.
   $p_{n-1} \leftarrow p_n,\ a_{n-1} \leftarrow p_0,\ a_0 \leftarrow a_1$
6. Halt

For example, suppose we wish to obtain the product of 494 and 29 using a dozenal calculator or computer with 3-dit registers. We set decimal 494 in register A as dozenal 352, decimal 29 in register B as dozenal 025, and decimal 0 in register P as dozenal 000. The loop of this algorithm goes as shown in Figure 4.

*(Continued)*

| C | P | A | B | |
|---|---|---|---|---|
| 0 | 000 | 352 | 025 | ; initialize |
| 0 | 000 | 352 | | ; begin outer loop 1 |
| 0 | 000 | 352 | | ; begin inner loop, $a_0$=2 |
| | 025 | | | ; add B to P |
| 0 | 025 | 352 | | ; partial sum 1 |
| | 025 | | | ; add B to P |
| 0 | 04∗ | 352 | | ; partial sum 2 |
| 0 | 004 | ∗35 | | ; shift right one dit |
| 0 | 004 | ∗35 | | ; begin outer loop 2 |
| 0 | 004 | ∗35 | | ; begin inner loop 1, $a_0$=5 |
| | 025 | | | ; add B to P |
| 0 | 029 | ∗35 | | ; partial sum 1 |
| | 025 | | | ; add B to P |
| 0 | 052 | ∗35 | | ; partial sum 2 |
| | 025 | | | ; add B to P |
| 0 | 077 | ∗35 | | ; partial sum 3 |
| | 025 | | | ; add B to P |
| 0 | 0*0 | ∗35 | | ; partial sum 4 |
| | 025 | | | ; add B to P |
| 0 | 105 | ∗35 | | ; partial sum 5 |
| 0 | 010 | 5∗3 | | ; shift right one dit |
| 0 | 010 | 5∗3 | | ; begin outer loop 3 |
| 0 | 010 | 5∗3 | | ; begin inner loop 1, $a_0$=3 |
| | 025 | | | ; add B to P |
| 0 | 035 | 5∗3 | | ; partial sum 1 |
| | 025 | | | ; add B to P |
| 0 | 05* | 5∗3 | | ; partial sum 2 |
| | 025 | | | ; add B to P |
| 0 | 083 | 5∗3 | | ; partial sum 3 |
| 0 | 008 | 35∗ | | ; shift right one dit |
| 0 | 008 | 35∗ | | ; halt |

**Figure 4: The product 29 ∗ 494 using 3-dit dozenal REGISTERS**

The dozenal result 835∗ converts to decimal as 14,326.

We can divide two dozenal numbers a and b located in n-dit registers to obtain the result a/b in dozens. The symbol $-_z$ denotes subtraction in dozens. The algorithm goes as follows.

1. Initialize registers A, B, and P

   $A \leftarrow a, B \leftarrow b, P \leftarrow 0$

   $p_{n-1} \leftarrow p_{n-2}, p_0 \leftarrow a_{n-1}, a_1 \leftarrow a_0, a_0 \;\underline{?}$

*(Continued)*



2. Loop n times steps 3 through 5
3. Shift each dit in register pair PA one dit to the left and assume that $a_0$ is temporarily vacant
4. Let $P = P -_z B$
5. If P < 0

   Set $a_0 = 0$
   $P = P +_z B$
   Else
   Set $a_0 = 0$
   Repeat
      $a_0 = a_0 + 1$
      $P = P -_z B$
   Until P < B
6. Halt

For example, suppose we wish to obtain the quotient and remainder of 855 divided by 34 using 3-dit registers. We set decimal 855 in register A as dozenal 5#3, decimal 34 in register B as dozenal 02∗, and decimal 0 in register P as dozenal 000. The loop of our algorithm goes as shown in Figure 5.

| P | A | B | |
|---|---|---|---|
| 000 | 5#3 | 02∗ | ; initialize |
| 000 | 5#3 | | ; begin loop 1 |
| 005 | #3? | | ; shift left |
| -02∗ | | | ; subtract B from P |
| -015 | #30 | | ; result negative, set $a_0$=0 |
| 02∗ | | | ; add B to P to restore P |
| 005 | #30 | | ; begin loop 2 |
| 05# | 30? | | ; shift left |
| 05# | 300 | | ; begin inner loop, $a_0$=0 |
| -02∗ | | | ; subtract B from P |
| 031 | 301 | | ; result not negative, $a_0$=1, P≥B |
| -02∗ | | | ; subtract B from P |
| 003 | 302 | | ; result not negative, $a_0$=2, P<B |
| 003 | 302 | | ; end inner loop |
| 003 | 302 | | ; begin loop 3 |
| 033 | 02? | | ; shift left |
| 033 | 020 | | ; begin inner loop, $a_0$=0 |
| -02∗ | | | ; subtract B from P |
| 005 | 021 | | ; result not negative, $a_0$=1, P<B |
| 005 | 021 | | ; end inner loop |
| 005 | 021 | | ; halt |

**Figure 5: The quotient and remainder of 855/34 using 3-dit DOZENAL REGISTERS**

*(Continued on page 15)*

# SAVE THE INCH

*William J Holdorf*

*Give the government an inch and it will take a kilometer.*

The federal government, through the Department of Weights and Standards, establishes what are the exact lengths of anything. In the Anglo-Saxon world, which we are a part of, that means an inch, a foot and a yard has an exact meaning and length. That standard is now under attack by a group of social reformers in government who believe we must join the French Revolution which gave birth to a new set of measurements called the decimal metric system.

While a great number of countries have adopted the decimal metric system, the United States has held out, and that bothers the social reformers. They feel we have to join the rest of the world in employing the decimal metric system in order to compete in the world of business. They forget, the United States has created the greatest financial and industrial nation in the world; the greatest amount of wealth for the greatest number of people; has created the greatest number of inventions; and provided the greatest amount of money and gifts to other nations and peoples in need, both through government grants (our taxes), and through charity from numerous private organizations, all the while we were using our system of measurement, which we inherited from our great English heritage. If there is something wrong with the measurement we have been using for centuries, it certainly has not stopped us from being tremendously successful in a world that has seen governments and nations rise and fall while using the decimal metric system.

The inch is something not to treat lightly. It has served the United States well for over two hundred years. In fact, it has even outlived the very French government that adopted the decimal metric system during the *Reign of Terror* by skeptics in 1790. Leaders of the French Revolution rejected anything that savored of the Divine or was linked to the past they considered corrupt. In spite of the new French government's search for purity, the Revolutionary French government, itself, changed form, and additional French governments changed form numerous times since the adoption of the decimal metric system, which certainly should be a warning that the decimal metric system enhances no stability to a government or nation.

The decimal metric system really has no claim to being more beneficial or even more scientific than the inch. In fact, the very foundation of the decimal metric system of measured was conceived in error. The French merely estimated the length of a quadrant of the earth's circumference along the meridian passing through, naturally, Paris. The length was divided by 10,000,000 and so the unit of a meter was obtained. The leaders of the French government were greatly mistaken since the earth is not a perfect circle. Their estimate was in error by 100,000 inches, or 254,000 centimeters, which ever you prefer.

*(Continued)*



Nonetheless, the French set the meter in motion as they determined it, and have been attempting for centuries to convince other nations to commit the same error.

While the French Revolution might have given birth to the decimal metric system, over the decades some countries adopted slight variations to suit their own fancy and national pride. That being the case, today, there really is not one world wide uniform metric system. With the United States attempting to change over to the decimal metric system, the big question is: *which one?* That is, from the various decimal metric systems in the world, which country's standard will the United States favor? Further, once determined, countries with slight alterations will remain at odds with our American products shipped overseas, which contradicts the very reason given by metric advocates who claim the United States must change to the decimal metric system to bring exported products in line with a single standard of measurement for world wide acceptance.

There is another factor to consider if there is going to be a dramatic change in the manner in which we measure things. By forcing the American public to join the decimal metric systems in the world, social reformers in government are denying the American public the option of adopting or considering the more intelligent dozenal metric system.

As for the inch, its pedigree dates all the way back to the Romans when a foot was something associated with a real foot, that is, the distance from the heel of a Roman to his big toe. The Romans divided that distance, as they determined it, into twelve *unciae*, from which both the inch and the ounce was fashioned, an ounce being one-twelfth of a pound.

*(Continued)*

**Dits and Dozens** *(Concluded)*

The dozenal result is in two parts. The left part P gives the remainder 005 and the right part A gives the quotient 021. Here the dozenal remainder 005 converts to decimal 5 and the dozenal quotient 021 converts to decimal 25. In decimals, 855/34 is 25 with a remainder of 5.

Dozens can be fun and can lead to many interesting mathematical and computing excursions.

*Editor's Note:* The above paper was presented by John at our Annual Meeting on October 19, 1996.

□

Of course, everyone did not always concur with the Romans through the centuries and , as a result, the foot was divided into various lengths. In the seventeenth century, the Dutch used eleven inches for a foot. However, the inch, itself, still survived, if the foot did not. In addition, King Henry I established a yard in the twelfth century as the distance from the tip of his nose to the tip of his outstretched thumb. And afterwards, as kings will do, Edward I did not approve of what his predecessor did and changed it to three feet in thirteen hundred five.

The inch has rightfully earned its way throughout the centuries of human history not only in terms of measuring exact proportions, but has even endowed poetic meaning in great literature, such as Shakespeare's *Ay, every inch a king.* And as a standard for larger measurements, such as the mile, the words of Robert Frost have an understandable message in:

*The woods are lovely, dark and deep*
*But I have promises to keep,*
*And miles to go before I sleep,*
*And miles to go before I sleep.*

If Robert Frost had lived under our present day bureaucratic social reformers in government who are attempting to legislate society's measuring mind under threats of punishing those who oppose the decimal metric system, his distinguished poetic expressions would have taken on a mundane and dreary:

*And kilometers to go before I sleep,*
*And kilometers to go before I sleep.*

It is nonsense to think that any nation that does not adopt the decimal metric system of measurement will lose its financial and industrial place in the business world. The greatest industrial and financial center is still the United States, and for the United States to be forced to accommodate lesser industrial and financial nations that have foolishly adopted their measurements to the awkward and confusing metric system, is ridiculous. It should be the reverse.

Of course, politicians are a breed all alone, many times apart from the sphere of logic and reason, and even far from the wisdom and will of the constituency that elected them. They

*(Continued )*





are ignoring the fact that converting to a decimal metric system in the United States takes on a financial disaster. Just to change all the signs on all the public roads in this country will consume hundreds of millions of tax dollars with no redeeming benefit to travelers or the taxpayers. Such funds will only be wasted. Such taxes would be better spent on more intelligent purposes, such as making much needed road repairs and improvements in order to provide for safer travel. What is even worse to realize, at a time when federal road improvement and construction tax dollars to the states are waning because of restraints to balance the nation's budget, state governments will be forced to spend hundreds of millions (billions?) of those tax dollars just to convert all road signs, including those mile markers, from miles to kilometers, just to please other nations who prefer the decimal metric system in their own land.

The cost of the boondoggle of changing roadway signs is just the tip of the metric financial iceberg. All government contracts must now be measured using the decimal metric system, such as building plans and blueprints. Also, all government supplies must use metric standards, such as stationary and other office supplies, yet not one of those changes will increase our exports overseas. The fact is, the federal government is belligerently attempting to go metric with no redeeming financial benefit to the American taxpayer, whether the public will follow or not. No doubt, government bureaucrats feel once the decimal metric system is fully in place in the government, then they will more easily be able to apply their *coup de grace* to any opposition in the private sector. So much for the degeneration of freedom in America, thanks to our present day politicians who seem to value the whims and fancies of politicians in other nations more so than the will of the people in the U.S., the very same people they are supposed to represent.

Through the use of our hard earned tax dollars, the federal government is attempting to ram the decimal metric system down our throats, whether or not the people desire it, which clearly reflects the mental attitude of a dictatorship. It is time, therefore, to start voting out of office those in Congress with such gross disrespect for the will of the people and, most importantly, such gross disregard for the intelligent use of our hard earned tax dollars, as well as our sacred American heritage in the way we successfully measured things over two hundred years.

Advocates of the decimal metric system are really attempting to force the United States to fix something that is not broken. We have had a proven track record of two centuries of economic growth with our present system of measurement; a growth record unsurpassed that is the envy of the rest of the world. The United States does not need to "measure-up" to the way other nations measure things; let other nations "measure-up" to our very successful measurement standards.

*Editor's Note:* Mr. Holdorf is a retired office manager from Illinois who worked almost two dozen years for an insurance company. A letter from Mr. Holdorf to Gene Zirkel appeared in the last issue of the *Bulletin* (77;).

# SOLUTIONS TO THE PROBLEM CORNER

*Charles S. Ashbacher and Jay L. Schiffman*

In Volume 39(2), there are three problems which we reproduce here for ready reference:

Problem 1: In the year *98; (1556), Tartaglia conjectured that the sequence 1 + 2 + 4, 1 + 2 + 4 + 8, 1 + 2 + 4 + 8 + 14;,... was alternately prime and composite. Employing duodecimal notation, prove that he was erroneous by going far enough out into the sequence. In addition, do you see any correlation between this sequence and a finite geometric progression that leads to Mersenne Numbers and consequently even perfect numbers? (A *Perfect Number* is one that is equal to the sum of all its proper factors. For example, 6 is perfect; for 6 = 1 + 2 + 3. A *Mersenne Number* $M_p$ is a prime number of the form $2^p - 1$, where p is prime.)

Problem 2: Consider in the awkward base dek the pattern 9, 98, 987, 9876, 98765, 987654, 9876543, 98765432, 987654321, 9876543219, 98765432198, 987654321987,... Determine the number of primes in this sequence. (This mind boggler was adapted from the text *Mathematics For Elementary School Teachers*, Fifth Edition by Billstein, Libeskind, and Lott on Page 197; (Page 259). Publisher: Addison-Wesley. By the way, the authors do mention other number bases including our favorite base but alas not our society.)

Problem 3: Repeat the pattern treated in Problem 2 where this time all numerals are taken in the duodecimal base. Discover any differences while contrasting this problem to the previous Problem 2. Can one formulate a pattern with duodecimals leading to the same conclusion as the one deduced in Problem 2? Also consider what transpires if one considers the sequence of duodecimals in the pattern #, #*, #*9, #*98, #*987, #*9876, #*98765, #*987654, #*9876543, #*98765432, #*987654321, #*987654321#, #*987654321#*, #*987654321#*9,.... Are there any primes in this sequence?

Solution to Problem 1 by Jay L. Schiffman:

Observe the following:

1 + 2 + 4 = 7 (Prime)
1 + 2 + 4 + 8 = 13; = 3 x 5 (Composite)
1 + 2 + 4 + 8 + 14; = 27; (Prime)
1 + 2 + 4 + 8 + 14; + 28; = 53; = $3^2$ x 7 (Composite)
1 + 2 + 4 + 8 + 14; + 28; + 54; = *7; (Prime)
1 + 2 + ... + 54; + *8; = 193; = 3 x 5 x 15 (Composite)
1 + 2 + ... + 54; + *8; + 194; = 367; = 7 x 61 (Composite)

Hence Tartaglia's Conjecture is false. In fact, the next three cases produce composites as well.

*(Continued)*



Let us observe by the formula for the sum of a finite geometric progression that $S_n = [a(1 - r^n)] / (1 - r)$, where a = the first term of the progression, r = the common multiple or ratio between terms after the first, n = the number of terms and $S_n$ = the sum of these n terms. In our sequence, the common ratio between terms is 2, and 1 + 2 + 4 + 8 + 14; +...+ $2^n$ = 1 + 2 + $2^2$ + $2^3$ + $2^4$ +...+ $2^n$ = $(2^{n-1} + 1) / (2 - 1) = 2^n - 1$. We are seeking those values of n such that n = p (p a prime) and $2^p - 1$ is likewise prime, denoted by $M_p$.
Observe the following:
$M_2 = 2^2 - 1 = 4 - 1 = 3$; $M_3 = 2^3 - 1 = 7$; $M_5 = 2^5 - 1 = 27$; $M_7 = 2^7 - 1$ = *7; $M_{11} = 2^{11;} - 1$ = 48*7; which are all primes. Other values of p leading to Mersenne Numbers are 15; 17; 27; 51; 75; 8#; *7; 375; 427; 8*7; 1337; 13*1; 1*41; 2565; and 2687.
A Perfect Number of even parity (No odd perfect numbers are known) is of the form $2^{p-1}$ x $M_p$.
Note that if p = 2, then $2^{2-1}$ x $M_2$ = 2 x 3 = 6.
If p = 3, then $2^{3-1}$ x $M_3$ = 4 x 7 = 24;.
If p = 5, then $2^{5-1}$ x $M_5$ = 14; x 27; = 354;.
If p = 7, then $2^{7-1}$ x $M_7$ = 54; x *7; = 4854;.
If p = 11;, then $2^{11;-1}$ x $M_{11;}$ = 2454; x 48*7; = #29#854;.

*(Continued)*

**Minutes of the Annual Meeting** *(Concluded)*

Alice Berridge, Jay Schiffman, and Rafael Marino were proposed as our Nominating Committee for the coming year. They were elected unanimously.

Other Business:

Gene said that he has sent copies of the DSA videos to Mary Malone, Mary Newhall and Mrs. Dudley George. Their husbands appear as featured speakers. He reported that we had received 29 requests for single copies of *Excursions in Numbers* and 7 requests for multiple copies. Members agreed that this publication is a valuable information tool. Gene read letters from Courtney Owen and from Ian Patten for discussion. Members agreed that their suggestions ought to be adopted. Gene wrote to Long Island *Newsday* in regard to a recent article on Body Mass Index. He suggested that using the ratio kg/m is less efficient than using lb/in.

The meeting was adjourned at 4:20 PM.

Respectfully submitted
-Alice Berridge

□

Hence we see Tartaglia's Conjecture and its relationship to Mersenne Numbers and even perfect numbers after the initial perfect number (6).

Solution to Problem 2 by Charles S. Ashbacher:

It is clear that any number ending in the digits 2, 4, 6, or 8 is evenly divisible by 2 and hence cannot be prime. Furthermore, any number ending in 5 is evenly divisible by 5.

The sum of all the digits from 1 through 9 is 45, which is evenly divisible by both 3 and 9. By a well-known theorem in number theory, a number is evenly divisible by 3 or 9 if and only if the sum of the digits of that number is evenly divisible by 3 or 9.

Given any sequence of digits 987654321, we know that the digital sum is evenly divisible by 3. If we append the digit 9 the sum is still divisible by 3. Appending the digits 987 adds 24 to the digital sum, which is still divisible by 3. Therefore all numbers ending in 9 or 987 are also evenly divisible by 3.

Appending the digits 6543 to any number ending in 7 adds 18 to the digital sum, so it again remains divisible by 3.

Finally, appending the digits 21 to any number ending in 3 adds 3 to the digital sum, so it again remains divisible by 3.

Therefore, the sequence given in Problem 2 contains no primes.

Solution to Problem 3 by Charles S. Ashbacher:

I wrote a short program to test Problem 3 and there is in fact a prime in the sequence: 987; = 1399. I ran the program up through
98765432198765432198765432198765432198765432 1987;
and found no additional primes.

If the digits # and * are included, then of course # is prime. In a short computer search up through
#*987654321#*987654321#*987654321#*98;
only the prime #*98765; = 35535677 was found. Therefore, there are primes in the sequence. The number of such primes, however, is unknown.

*Editor's Note:* I tested Problem 3 using the computer package **MATHEMATICA** (Wolfram Research Inc.) using the code FactorInteger[] and arrived at the same conclusions as Charles after converting the duodecimal integers to the awkward base dek. I would personally be interested if Charles would be kind enough to inform us of the program he utilized in his search.

□



# DOZENAL JOTTINGS

Dr. Tony Glaser pointed out that the playwright, George Bernard Shaw was a dodekaphile. Tony found the following quote in *Shaw: An Autobiography* edited by Stanley Weintraub and Published by Weybright and Talley, NY, page 254.

> He advocates a combination of the metric system with the duodecimal by inserting two new digits into our numeration, thus : eight, nine, dec, elf, ten, and eighteen, nineteen, decteen, elfteen, twenty, and so forth.

Our new secretary is Christina Scalise number 35*! Christina was one of the students at our Hofstra meeting on October 19, 1996. She thinks we were "really neat".

Whittier Publications proudly announced the printing of *"Happiness Is My Decision"* by Prof. Gene Zirkel of Nassau Community College. In his book, Gene expounds the ideas he has been presenting in his personal growth seminars: goal setting and goal achievement through positive self talk, affirmations, visualizing success, and additudinal changes. For more information, please contact the publisher:

Whittier Publications Inc. / 20 West Park Avenue
Long Beach NY 11561-4924
(516) 432 8120 / $12.95 + $3 Shipping & Handling

□

## A Note From Our Treasurer

*Alice Berridge*

We appreciate those members who dutifully pay their annual membership dues in an expeditious manner. Please be aware that dues are payable on January 1st and are only a dozen dollars. This fee is quite nominal when contrasted with other professional organizations. Life Members can come on board for a one-time fee of one gross dollars ($144). The Society greatly appreciates those members who generously donate a few extra dollars with their annual dues. The Society is an educational vehicle preaching the gospel "Twelve Is Best." Our goal is to recruit new members including students and to keep our high quality bulletins and other literature flowing. We recently received a note from a student who could not afford the full annual dues but nonetheless welcomed him enthusiastically. We feel that **The Dozenal Society of America** serves an essential function in the educational landscape. Naturally, we must maintain our upkeep as well as our membership. This can only be accomplished with your help. We greatly thank those many who have supported us in the past and look forward to many profitable ventures in the future. Happy New Year and best wishes in 11*5!

□

# THE FIRST THREE DOZEN FIBONACCI NUMBERS

*Jay L. Schiffman*
*Rowan College of New Jersey*
*Camden Campus*

The Fibonacci Sequence is recursively defined as follows:
$FIB(1) = FIB(2) = 1$ while $FIB(N) = FIB(N - 2) + FIB(N - 1)$ whenever $N > 2$ and N is an integer. For example, $FIB(3) = FIB(1) + FIB(2) = 1 + 1 = 2$. In the table that follows we present the first three dozen Fibonacci Numbers in the dozenal base.

| *N* | *FIB (N)* | *N* | *FIB(N)* |
|---|---|---|---|
| 1 | 1 | 17 | 2505 |
| 2 | 1 | 18 | 3*#9 |
| 3 | 2 | 19 | 6402 |
| 4 | 3 | 1* | *2## |
| 5 | 5 | 1# | 14701 |
| 6 | 8 | 20 | 22*00 |
| 7 | 11 | 21 | 37501 |
| 8 | 19 | 22 | 5*301 |
| 9 | 2* | 23 | 95802 |
| * | 47 | 24 | 133#03 |
| # | 75 | 25 | 209705 |
| 10 | 100 | 26 | 341608 |
| 11 | 175 | 27 | 54#111 |
| 12 | 275 | 28 | 890719 |
| 13 | 42* | 29 | 121#82* |
| 14 | 6*3 | 2* | 1*#0347 |
| 15 | #11 | 2# | 310##75 |
| 16 | 15#4 | 30 | 5000300 |

□

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.



# 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 ten. 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).**

# WHY CHANGE?

This same question was probably rife in Europe in the late middle ages when the new Hindu-Arabic numerals were inching forward, displacing the comfortable and familiar Roman numerals then universally used.

Yet, although it took five centuries and in spite of much opposition — ("Who needs a symbol for nothing?") — the better notation did come into popular use. Released from the drag of Roman Numerals 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 accommodated 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, people awoke to the fact that different number bases could be used.

A parallel to today seems tenable. The notation of the dozen base better accommodates 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 our 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 one and a third dozen 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. □



*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 ______________________________

Annual Dues ........................................ $12.00 (US)

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

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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
%Math Department
Nassau Community College
Garden City, LI, NY 11530

DETACH HERE -- OR -- PHOTOCOPY