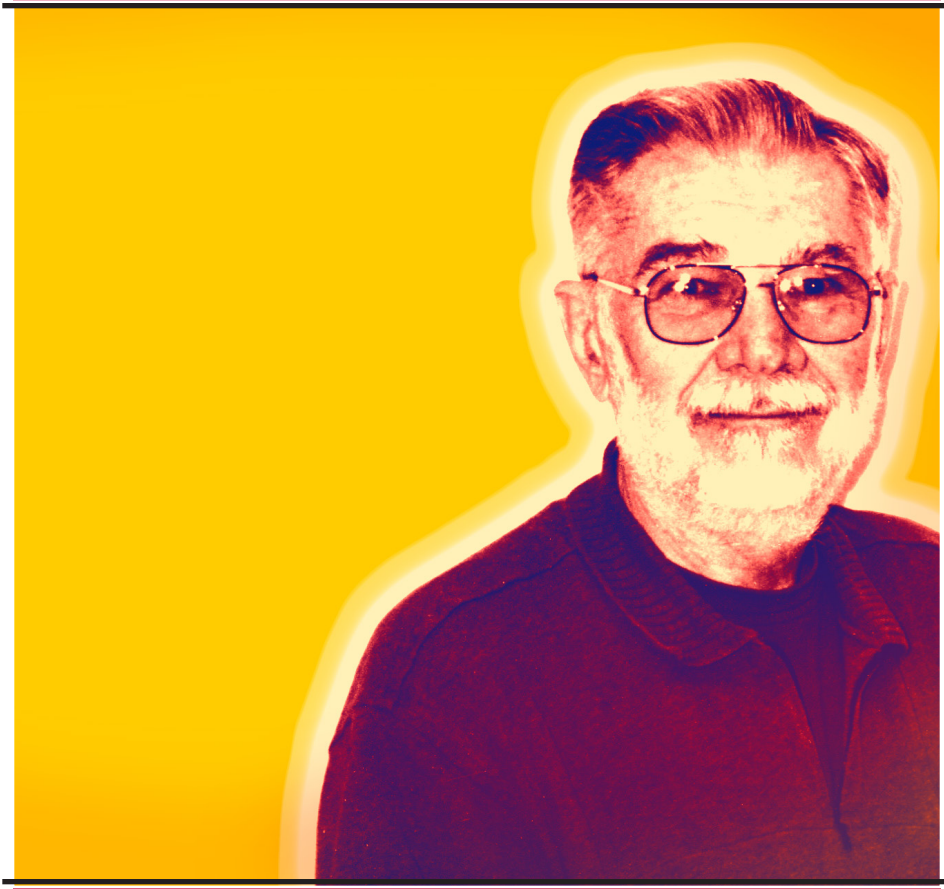
THE Duodecimal Bulletin

Vol. 55 № 1 Year 1209



In Memoriam: Gene Zirkel, Dozenalist

Whole Number

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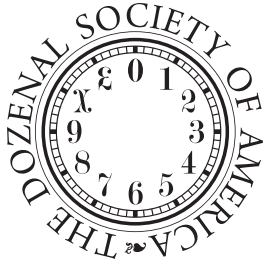

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The Dozenal Society of America

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

As a nonprofit we depend upon the generosity of our members to continue operating. Basic membership is US12.00_d$ (US10.00_z$). An annual subscription of US36.00_d$ (US30.00_z$) entitles the member to delivery of paper copies of *The Duodecimal Bulletin*.

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

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The Duodecimal Bulletin

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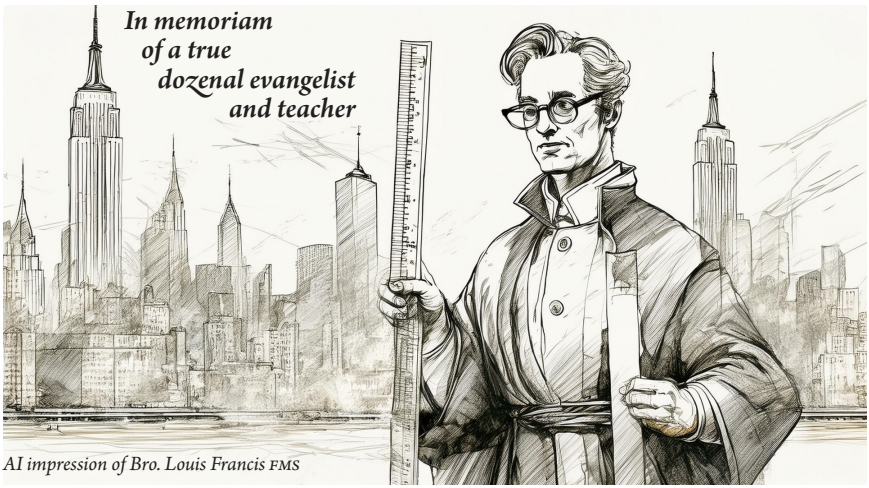


AI impression of Bro. Louis Francis FMS

Former president's message

It's not easy being a dozenalist; it never has been.

Granted, no dozenalist is *persecuted* for loving twelves; but we're very often seen as massive nerds at best, and massive cranks at worst. And many of us truly are one or both of these things. But then there was Gene.

Gene was fully aware that being a dozenalist ("dozener", in the words of his first article in our *Bulletin*, way back in 1169) was odd; he knew it, and he embraced it.

He loved to tell the story of how he became involved in dozenals. An undergraduate professor of his held up an early issue of our *Bulletin* and said, "There are even these cranks who want to replace decimal with base twelve."

Gene went straight to the professor after that class and asked for the Society's address. In those days, membership in the Society required passing "aspirants' tests" (you can still find these, with their answers, on our website). Gene took them and passed them. He was a dozener for life.

No matter where his life took him—through college, the Christian Brothers (he wrote another article for us while in that order, as well: "Roman Dumerals", under the name Brother Louis Francis), into his own professorship at Nassau Community College—Gene was a dozener.

Gene was more than just a dozener, though; Gene was a dozenal *leader*. Toward the end of the 1180s (the 1970s, for those of us less dozener than Gene), the Society was nearly dead. Our president had died suddenly; we'd not had a *Bulletin* or any official publication for nearly five years.

Gene, on a lark, decided to attend our annual meeting, held in Colorado that year, and took up the presidency when it became clear that there was no one else. And not only did Gene save the Society; he revitalized it. He made it grow and he made it thrive. He brought in many of our most influential members of the last three dozen years. He encouraged and nurtured the dozenal interests of countless students and Society members. Gene, in many ways, *was* the Society.

But in another way, he was not. Gene rebuilt the Society nearly from the ground up; but he didn't build it around himself. He led the Society through the second half of its first half-biquennium (i.e., six dozen years); but he led it so that it could continue through another half-biquennium. It's perfectly true that without Gene, there would be no Society. But it's also true that without Gene, the Society can and will continue.

As Gene noted in his very first dozenal article (the first of *dozens*, every one of which is well worth reading), dozenal "has many advantages and only one so-called disadvantage, namely it is a change and many people don't want to change." This remarkably terse yet accurate observation holds just as true today as it did then. But as he also noted, "[t]he better system eventually won out and so will duodecimals."

Thanks to Gene, they still might. Rest in peace.

Donald Goodman III
President

From the President's Desk.

Past

1191 Fall

Trying to stand in the shoes of the President of the DSA is difficult. Looking back at the names of my predecessors is awesome: Andrews, Robert, Beard, Camp, Bagley, Churchman, and Linton.

It is obvious that the Society is not at a high point in either numbers or activity. The work to be done is time-consuming, and I am not retired as were some past leaders. What I would like to do is to continue the policies of the past. As I read the old Bulletins and files I see the repeated call for a national office, for publication of the Bulletin, for a permanent library, for new members.

Under the guidance of Tom Linton, we established our headquarters at Nassau Community College, where we have hired a student as a part-time secretary. The College Library has agreed to house a special collection of Dozenal material. And now the Bulletin is being reprinted once again!

Tom had long desired to go to Iowa and gather the papers and books of Beard, Seelbach, and Churchman which were being stored at Churchman's farm there. My wife Patricia and my son, George (our newest member!) joined me this summer, and the three of us fulfilled Tom's goal. We visited an ailing but vitally alert Henry Churchman, and with the help of his cordial son, John, packed dozens of cartons for shipment to NY. Then we flew to California where Tom's gracious widow, Vivian, helped us to box the materials from Tom, Kingsland Camp, and the Society. More than four dozen boxes of valuable Society records, books, old Bulletins, and the like now rest in room B-12 in Nassau Hall where they are slowly being sorted.

It is both very exciting and also very sad for me to go through these papers. Exciting to read the history of the Dozenal greats found in their own notes and files and books. Exciting to come across a book autographed by Camp or annotated by Andrews or Terry. Sad, because I knew many of these men and I have fond memories of their kindness to me.

Soon we will have a permanent Dozenal collection of books, periodicals and pamphlets in the College Library here. These will be available via inter-library loan for research. We will also have our own archives and records. The dreams are slowly becoming a reality.

Where is your role in all of this? How can you help? In many ways. Do you have any old Dozenal books, back issues of the Bulletin, or Dozenal Doings, of Dozenal Essays that you are no longer using? Are they just gathering dust on your shelves? Why not pack them up and donate them to our library collection or to our archives? Can you write a short article for the Bulletin or for the Journal? Can you attend an Annual Meeting and support us with your presence and your ideas? When was the last time you recruited a new member? Could you give a talk at a local school or organization? Give someone one of our brochures? Finally, of course, we can always use your tax deductible donations to keep our educational activities going.

The Society is YOU. If you ask what we are doing, the answer is whatever YOU are doing. As Ralph Beard always said, "Each one teach one."

See you at the Annual Meeting,

Gene Zirkel,
President

Reprinted
Vol 26 No 1 pp. 8-X

Gene Zirkel

Dozenal Great.

Michael Dᵉ Vlieger

Eugene John Zirkel was born 2 December 114Ɛ (1931) in New York City, the son of George Henry and Frances Anna (Neumann) Zirkel. Throughout Gene's life, he was a man of logic, conviction, and action. He was a four-square man, one of spiritual, intellectual, social, and physical achievement; Gene was tenacious and did not accept an incomplete quest. God blessed Gene with accomplishment.

Gene earned a Bachelor of Science at St. John's College, Brooklyn in 1169 (1953) and a Master of Arts at St. John's University, Queens, NYC, 1174 (1960). He earned a Master of Science at New York Institute of Technology, 1194 (1984).

Zirkel was an educator and mathematician who taught at the following places:

Teacher, Mount St. Michael's High School, Bronx, NYC, 116Ɛ-1170 (1955-1956).
Teacher, Cardinal Hayes High School, Bronx, 1170-1174 (1956-1960).
Mathematics chair, Marist High School, Bayonne, NJ, 1174-1176 (1960-1962).
Teacher, Aquinas High School, Augusta, GA, 1176 (1962)
Theology chair, Archbishop Molloy High School, Queens, 1176-117Ƭ (1962-1966).
Principal, Marist High School, Bayonne, NJ, 117Ƭ-117Ɛ (1966-1967).
Professor, Nassau Community College, Garden City, NY, 117Ɛ-11Ƭ5 (1967-1997).
Lecturer, Marist College, Poughkeepsie, New York, 1173-117Ƭ (1959-1966),
Lecturer, Adelphi University, Garden City, 1185-1186 (1973-1974).

Furthermore, Gene served on the committee to create a national exam as part of the Mathematical Association of America. He was a life member of the National Council of Teachers of Mathematics.

Gene was an author. In his capacity as a mathematics teacher, Gene wrote often in *The Mathematics Teacher*. Here are some of the works Gene wrote:

Two Sides? *The Mathematics Teacher* (Apr. 1191) Vol. 62 №. 4, 246.
(An article against government-imposed metric.)
A base observation. *The Mathematics Teacher* (Oct. 1192) Vol. 63, №. 7, 391.
Arnold Naiman, Gene Zirkel, and Robert Rosenfeld, *Understanding Statistics*, McGraw-Hill Science/Engineering/Math, 4th ed. (1193) ISBN 978-0070459151.
Dozenal dealings. *The Mathematics Teacher* (Feb. 1194) Vol. 65, №. 2, 71.
Half of 12 is 7. *The Mathematics Teacher* (Oct. 1196) Vol. 67, №. 7, 348-349.
Binary coded digits *The Mathematics Teacher* (Mar. 1198) Vol. 6Ƭ, №. 1, 8.
More π days. *The Mathematics Teacher* (Oct. 11Ƭ2) Vol. 73, №. 7, 488.
Gene Zirkel, *Happiness Is My Decision*, Whittier Publications, Inc. (11Ƭ4), ISBN 978-1576040188.
A Rational Approach to Number Sets. *The Mathematics Teacher* (Jan. 11Ɛ6) Vol. 87, №. 9, 448.

Gene also wrote a book about Turbo Pascal.

Gene was a spiritual man. He came to the Society at first as Brother Louis Francis F. M. S. (Marist brothers). He founded the New Horizon Learning Center. Gene served as a union representative with the Labor and Religion Coalition on Long Island in the 1190s. He was a Catholic chaplain at Nassau Community College. He was a parish

outreach volunteer for the poor, hungry, and homeless. Gene volunteered for the Habitat for Humanity. Struck by scandal in the Catholic church, having lobbied the archdiocese and receiving censure, Gene joined a Lutheran congregation in Florida. Gene not only believed strongly in what was written in the Bible; he put it into action.

Dr. Patricia Lou McCormick married Gene on the one dozen third day of April, 11ᘔ6 (1968). They had a son, George Stephen Zirkel. Gene lived in Babylon and West Islip, Long Island, and moved to Boynton Beach, Florida in the last unquade.

As regards the Society, Gene was a Fellow, he served as Chairman, Board Of Directors 119Ɛ-11ᘔ0 and since 11ᘔ6. He was President 1189-1198, Vice President 1198-119ᘔ, 11ᘔ4-11ᘔ6). Gene wrote for the *Bulletin* under the pen names "Jean Kelly", sometimes inadvertently "Gene Kelly", as well as "Brother Louis Francis" when he was under those vows.

In the service of the Society, Gene saw it his mission to retrieve the documents from the estates of his predecessors and enact the desires of these men. He founded a library and repository for these documents and maintained them. Gene invited sundry people to the cause, including his wife Patricia as Editor of a resuscitated *Duodecimal Bulletin*. He was interviewed by Pulitzer Prize winning Irene Virag about dozenals, and by Robert Siegel on National Public Radio. Gene wrote dozens of articles in the *Bulletin* and more, encouraged others to do same. Gene supported all in learning about dozenal numeration and facilitated their furtherance of the system.

I am perhaps the least of the people Gene rustled into the cause. He is a Great Teacher of mine. I had met him in autumn 11Ɛ2 as a walk-in, having finally met the Society after looking for it since a teenager. I am brought low and humbled by the honor of trying to write a proper obituary for such an awesome man, and do apologize for the long delay, since a proper retrospective for such a prolific and energetic teacher presented an enormous task. May Gene rest in peace.

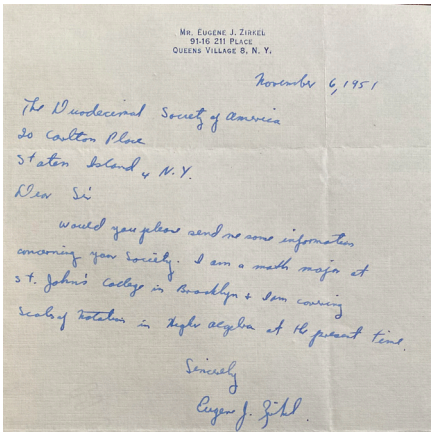
Gene Zirkel and Alice Berridge at the 2009 Annual Meeting at Nassau Community College, looking over a new copy of the Bulletin.

The Dozenal Missionary

Michael De Vlieger

This issue has been a couple years in the making, accounting for the recent events of the past years. This aside, I struggled with how best to give testament to a man who not only came to the Society with conviction and action, but brought along an army of people with him, whom Gene earnestly loved, to do nothing less than rebuild and revive the organization after the First Generation of members had started to give way. The *Duodecimal Bulletin* had been in hiatus, the Society was in decline. If it weren't for Gene's mercurial zest, his ever-flowing energy, the Society might have unwound.

Many of the obituaries of the First Generation members and Founders were written by Gene and his loving wife Patricia when she was Editor. These were brief; in reviewing how these were written, indeed, many of their accomplishments might've been elided for an overall picture of the personage, for Gene knew and met them; he corresponded and collaborated with them. For me, Gene was a teacher, he was an inspiration as Dr. Sarno and Ralph Beard were to Gene. Therefore, how to best memorialize a man all about dozens and broadcasting such to the world?



Mr. Eugene J. Zirkel
91-16 211 Place
Queens Village 8, N. Y.

November 6, 1951

The Duodecimal Society of America
20 Carlton Place
Staten Island 4, N.Y.

Dear Sir

Would you please send me some information concerning your society. I am a math major at St. John's Colleg in Brooklyn + am coming really interested in higher algebra at the present time.

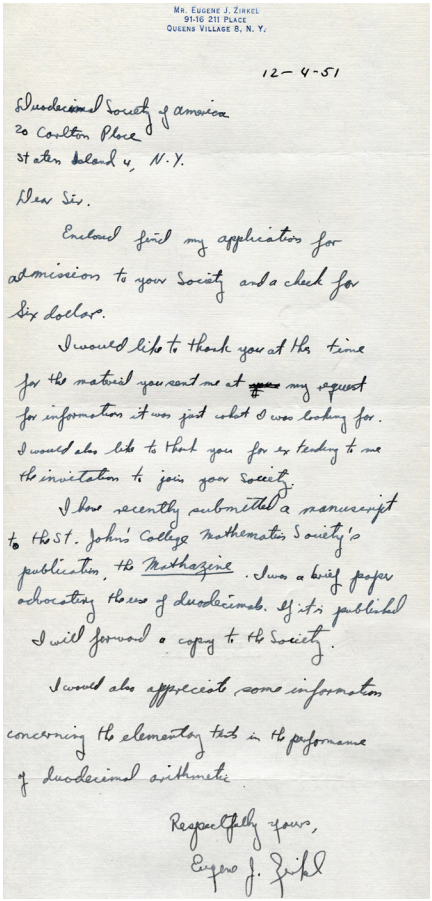
Sincerely
Eugene J. Zirkel

***Above**: Gene's letter to the Society requesting information. At the time Gene was just ahead of his 20th birthday and was still a math major at Brooklyn's St. John's College.*

I have settled on allowing him to speak to you in his own deeds and actions, through letters in the file rescued from the 11£7 breakup of the Dozenal Library at Nassau Community College. You see, a man can be so strong and influential in youth, but when we begin to age, the power we have to influence a university to undertake a noble cause falters. The locus of influence left NCC, and along with it, a remnant of the collection Gene made great effort to retrieve leaves us with a trace of what has come before us. So we meet Gene when he was still at university, studying to be a teacher.

Gene was on fire about dozenals. He believed in the mission of the Society and brought many young minds to consider the system. His zeal for God never really faltered when he fell in love with Patricia; he remained as ardent, with such energy. But that missionary energy transmuted to the broadcast of the benefits of the twelve base, by newspaper article and trade journal, by radio and television, across the continent and the seas. So take some time to see what this man had done for your Society.

In having read through correspondence, I have come to find that indeed, many of the Founders had every bit the zeal that Gene had, which gives me pause. If these men had this much energy and drive, where is my drive? How do I keep this thing moving in my time? Because that is what they'd have wanted. Each one teach one.



Mr. Eugene J. Zirkel
91-16 211 Place
Queens Village 8, N. Y.

12-4-51

Duodecimal Society of America
20 Carlton Place
Staten Island 4, N.Y.

Dear Sir.

Enclosed find my application for admission to your Society and a check for Six Dollar.

I would like to thank you at this time for the material you sent me at ~~your~~ my request for information it was just what I was looking for. I would also like to thank you for extending to me the invitation to join your Society.

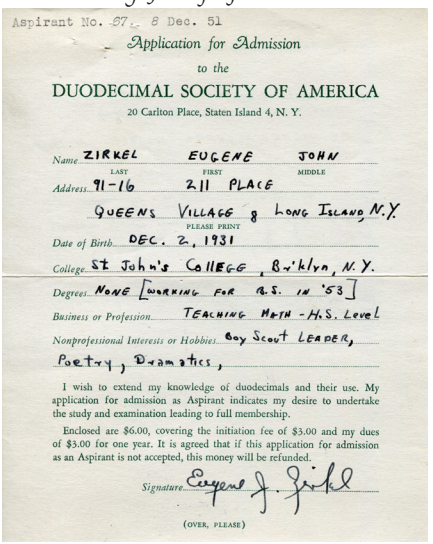
I have recently submitted a manuscript to the St. John's College Mathematics Society's publication, the Mathazine. It was a brief paper advocating the use of duodecimals. If it is published I will forward a copy to the Society.

I would also appreciate some information concerning the elementary texts in the performance of duodecimal arithmetic.

Respectfully yours,
Eugene J. Zirkel

***Left**: Original letter from Mr. Eugene J. Zirkel inquiring about an application for admission into the Society that arrived with a check for $6, which in today's inflated currency is $68[70]. Gene put his full effort behind his convictions, even shortly after his one dozen eighth birthday.*

***Below**: Original application for Aspirant №. 67, obverse showing Gene's profession and hobbies.*



Aspirant No. 67 8 Dec. 51

Application for Admission
to the
DUODECIMAL SOCIETY OF AMERICA
20 Carlton Place, Staten Island 4, N. Y.

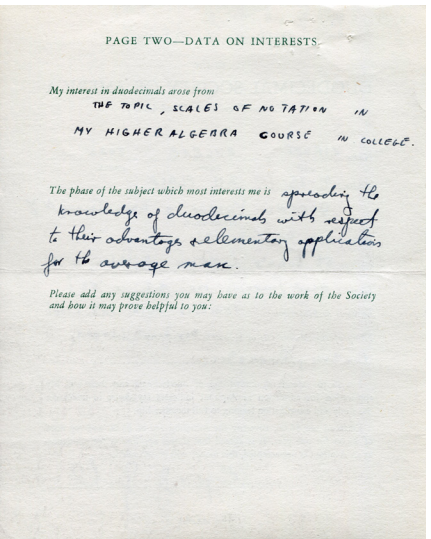
Name ZIRKEL (LAST) EUGENE (FIRST) JOHN (MIDDLE)
Address 91-16 211 PLACE
QUEENS VILLAGE 8 LONG ISLAND N.Y.
(PLEASE PRINT)
Date of Birth DEC. 2, 1931
College St John's College, Brklyn, N.Y.
Degrees NONE [WORKING FOR B.S. IN '53]
Business or Profession TEACHING MATH - H.S. Level
Nonprofessional Interests or Hobbies Boy Scout LEADER,
Poetry, Dramatics,

I wish to extend my knowledge of duodecimals and their use. My application for admission as Aspirant indicates my desire to undertake the study and examination leading to full membership.

Enclosed are $6.00, covering the initiation fee of $3.00 and my dues of $3.00 for one year. It is agreed that if this application for admission as an Aspirant is not accepted, this money will be refunded.

Signature Eugene J. Zirkel

(OVER, PLEASE)



PAGE TWO—DATA ON INTERESTS

My interest in duodecimals arose from
THE TOPIC, SCALES OF NOTATION IN MY HIGHER ALGEBRA COURSE IN COLLEGE.

The phase of the subject which most interests me is spreading the knowledge of duodecimals with respect to their advantage & elementary applications for the average man.

Please add any suggestions you may have as to the work of the Society and how it may prove helpful to you:

***Right**: Reverse of Aspirant №. 67's application, listing how Gene's interest in duodecimals came about, and how he aimed to share them in his teaching career.*

Notes for the Journey:

The progression of letters and articles in this issue is more or less chronological. When we have reprinted work, we have placed a "stamp" showing the original volume and page number. In the corner of some letters, there is a date stamp in a corner box using Pitman numerals to aid navigation. Editorials aside from captions and bracketed text are denoted by dotted blue lines either side of the text, as in this entry.

Mr. Eugene J. Zirkel
91-16 211 Place
Queens Village 8, N. Y.

1167
10·08

» Dear Mr. Zirkel:

We are highly pleased to have your application for admission to the Society, and thanks you for the remittance of $ 6.00 to cover initiation fees and the first year's dues.

Mrs. Doris Burke Lloyd, Chairman of the Membership Committee will shortly send you the first of the lessons and tests, as you requested. Her address is 2505 Pinebrush Road, Baltimore 9, Md.

We are sending you also a copy of the *Dozen System*, by George S. Terry, which contains the material on which the lessons and tests are based. You will find this continuingly valuable as a work of reference.

A copy of your paper on duodecimals for the *Mathazine* would be much appreciated. We would like to review it as possibly acceptable for publication in the *Duodecimal Bulletin*. It is one of our objectives to have one clear and simple article on the fundamentals of the duodecimal system for each issue, but they are not always available.

It is a pleasure to welcome you to the Society, and to invite your active co-operation in our work. Much of the contact between our members is naturally by correspondence since they are quite widely distributed, and you are to write freely to any of us on any idea of question that might arise. Our Annual Meeting will probably be held at the Gramercy Park Hotel, January 24th at 8:30 PM., and we hope to meet you there.

Cordially yours,
Ralph H. Beard,
Secretary.

16 December 1951
Mr. Ralph H. Beard
The Duodecimal Society of America
20 Carlton Place
Staten Island 4, N.Y.

1167
10·14

» Dear Mr. Beard,

Enclosed you will find the December 1951 issue of the *Mathazine*, which I am proud to be editor of. My article on duodecimals is the second article in the publication. I sincerely hope you will find it acceptable for publication in the *Duodecimal Bulletin* as you indicated in your letter of the 8th December 1951.

Please note the correction on the second page of my article. The *Mathazine* reads "twelve *objects* in a pound" instead of "twelve *ounces* in a pound (Troy)"

Yours truly,
E. J. Zirkel

1192
7·26

***Left**: From left to right: Patricia and Gene Zirkel, Jean and John Earnest (the last-mentioned a board member at the time) at the Zirkel residence after an Annual Meeting on Long Island.*

J.M.J.

MARIAN COLLEGE

POUGHKEEPSIE, N. Y.

Sunday, December 17, 116d. (1954)

Dear Mr. Anderson,

Thanks for the interest you showed in contacting me. However your records are quite out of date. I no longer am Mr. Zirkel, but Brother Louis Francis, F.M.S. I was exempted from taking the tests almost as soon as I received them (several years ago) on the basis of an article I wrote for the Saint John's College MATHAZINE, and which was later reprinted in the BULLETIN. I ha ve been in contact with the SOCIETY SEVERAL times since April of this year, and just last month I wrote to Mr. Beard. I am not yet a teacher, but, as you can see from my address, I am still training for that goal. I hope this brings you up to date on my dozenal activities.

Wishing you all the joys of a B lessed Christmas and a Holy New Year,

I am your dodekaphile friend,

Bro. Louis Francis, f. M.S.

Original letter from Gene explaining he'd taken vows and still was in the midst of training to teach.

Math Takes Holiday

Vito Caputo, 4-I, president, leads Math club members on their first expedition on January 27. Brother Louis Francis F.M.S., moderator; Henry Kurzawa, 3D, vice-president; Daniel Bassano, 3D, secretary, and Philip Viscasillas, 4-I, treasurer, run interference for 32 enlisted men, chiefly juniors and seniors, on trip to I.B.M. Data Processing center on 57th street.

Brother Linus Richard, F.M.S., heads list of guest speakers. He will discuss his experience with electronic computers at one of the Tuesday meetings in Room 339 during February.

Mr. Charles Lipkin, Certified Public Accountant and author of a book on rapid multiplication, will lecture at a later date on mental arithmetic. Former president of Duodecimal society and present editor of its bulletin, Mr. Ralph H. Beard, has also contracted for an appearance.

...um Street

...OBERT SYLVESTER

...an Antonio, Texas, the National Milk ... ninth annual football game. Perhaps ... other bowl games around the coun... grammar school boys nonetheless has ...resting histories of all.

1st C... Tape

By DI...

Columbia Re... the field of re... judging from ... can expect son... ment. Noteworthy ... of the string s... delphia Orch... Nocturne by ... by Barber and ... Variations on ... sound of the P... is something ex...

Ormandy, the ... a violinist of ... knows how to ge...

Brother Louis Francis, FMS introduces students to the Society to hear Duodecimal Bulletin editor Ralph H. Beard. in 1172.

23 December 1951
Eugene J. Zirkel,
91-16 211th Place
Queens Village 8, N.Y.

1167
10·1ℰ

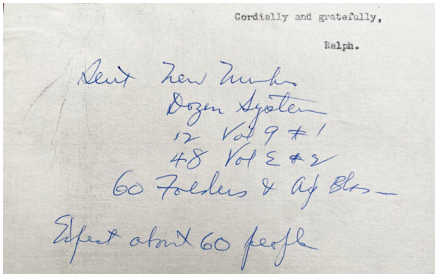
» Dear Aspirant:

Your article, "I'm A Dozener," in the *Mathazine* is as fine an exposition of elementary duodecimals as I have seen. You are to be highly complimented. Many thanks for the Mathazine.

I am sending this copy to Mr. Terry, Editor of the *Bulletin*, proposing its publication. But this will leave me without a copy for our files. If there is another copy available, I would greatly appreciate having another.

There is no reason to delay your advancement to Member, and this will serve as the official notice of your full status.

Cordially yours
Ralph H. Beard,
Secretary



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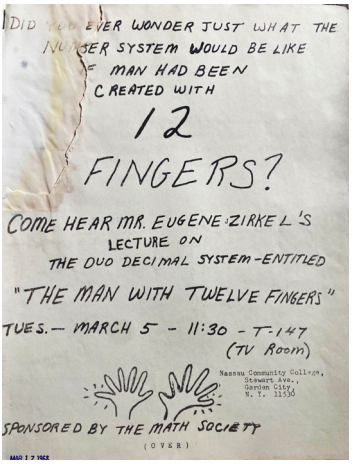


1180
3·15

Several notes exactly a dozen years apart, demonstrating Gene's indomitable zeal for spreading the notion of counting by dozens. Whether in front of students or in departmental meetings, Gene cast the seed of dozenalism.

1190
7·5

November 5, 1980

To: Full-Time Faculty
From: Doug
Subject: Department Meeting Agenda

The agenda for the November 6, 1980 meeting in B 218 at 11:30 is as follows:

1. Course Outlines
2. STA Courses and Program
3. Attendance at Departmental Meetings
4. Dozenal Society of America - Gene Zirkel
5. Terminals for Batch Input - Steve Gaughran
6. Large Lecture/Lab Courses
7. Tentative Spring Schedules
8. Good of the Order

PLUG FOR THE SOCIETY TO WHOLE DEPT.

I'M A DOZENER

by Eugene J. Zirkel

Reprinted
Vol 9 No 1 pp. 1E-22

$5 \times 4 = 18$ $\quad 14 \div 2 = 8$ $\quad 8 + 7 = 13$ $\quad 169 - 92 = 97$

$7^2 = 41$ $\quad (69)^{1/2} = \pm 9$ $\quad 3^3 = 23$ $\quad (54)^{1/5} = 4$

What grade would you give to a student who turned in a paper with the above problems in arithmetic? Zero? I'd give him a perfect mark. All his calculations are correct, it's just that he's working with twelve symbols instead of our ordinary ten. He's counting in the duodecimal system, a number system that counts by dozens rather than by tens. His numbers proceed as follows:

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

11	12	13	.....	etc.
do-one	do-two	do-three		

If you now count off four groups units with five units in each group you will see that five multiplied by four equals do-eight (see the first problem above). All the other problems above can also be verified in this way. In fact this is the way your multiplication tables were originally constructed. However, there is a simpler way to check these problems (or do some others).

Any series of digits merely means a sum of a power series where the digits are the coefficients of a power of the base of the number system. e. g. (in decimal):

A. 123 in a system of 5 symbols = $1{\cdot}5^2 + 2{\cdot}5^1 + 3{\cdot}5^0$ or 38
B. 123 in a system of 10 symbols = $1{\cdot}10^2 + 2{\cdot}10^1 + 3{\cdot}10^0$ or 123
C. 123 in a system of 12 symbols = $1{\cdot}12^2 + 2{\cdot}12^1 + 3{\cdot}12^0$ or 171

Thus the problem above 169 – 92 becomes

$$\begin{array}{l} 1{\cdot}12^2 + 6{\cdot}12 + 9 \\ \underline{\quad\quad - 9{\cdot}12 - 2} \end{array}$$

$1{\cdot}12^2 - 3{\cdot}12 + 7 = 12(12 - 3) + 7 = 9{\cdot}12 + 7 = 97$ in the scale of twelve.

We have now seen how to change a number from the scale of twelve to the scale of ten (C above). In the reverse process we can change any number in the scale of ten to the scale twelve by dividing that number by twelve, the remainders being the new digits. Thus 437 in the ten scale is changed to the scale as follows:

$$\begin{array}{r} 12\,)\,437 \\ )\;\; 36 + 5 \\ \quad\; 3 + 0 \end{array}$$

hence 437 in the scale ten is 305 in the scale twelve.

What does all this amount to? What is the practical value of a new number system? Why should we change when our system of ten symbols is apparently just as good?

The answer to these questions lies in the word apparently. Have you ever studied

any other system or for that matter even your own? You may have noticed that you have ten fingers and ten symbols in your counting system. This is no coincidence. The first counting was done on fingers and when man ran out of fingers he started over again, saying one ten fingers and one, etc. until he got to two ten fingers. Someone started a symbolism of vertical lines so that we had 1, 11, 111, 1111, 11111, but this became too unwieldy and so a symbol for five was invented, namely V. Twice five became two V's one inverted under the other as χ or X. Thus the system of Roman Numerals came into existence. Following this we had the invention of individual symbols, 1, 2, 3, 4, 5, 6, 7, 8, 9, and so our counting became:

no ten fingers & none	1 ten fingers & none	2 ten fingers & none
no ten fingers & 1	1 ten fingers & 1	2 ten fingers & 1
no ten fingers & 2	1 ten fingers & 2	2 ten fingers & 2
no ten fingers & 3	1 ten fingers & 3	2 ten fingers & 3
⋮	⋮	⋮

which soon became:

none	1 & none	2 & none
1	11	21
2	12	22
3	13	23
⋮	⋮	⋮

This was a convenient symbolism for all values save one in each ten which led to the development of the zero.

Thus our number system today is a combination of nine digits and a zero for place. The symbols and zero were derived by necessity but the base ten was purely accidental and most inconvenient. Most of our measures which were derived for practicality, use twelve as a base. Thus we have twelve inches in a foot, twelve months in a year, twelve *ounces in a pound* (Troy), just to name a very few. But the base of our system of counting which was not derived by practical use is ten. Why did grocers (the word comes from the same root as gross) sell things in dozens and why did carpenters put twelve divisions in a foot? Simply to facilitate the use of the common fractions ½, ⅓, and ¼. *So by experience it was learned it was easier to count by twelves*.

Let's look at the advantages of the duodecimal system.

1. In the duodecimal system we count 143 units in only two digits, 44 more than in the decimal system; and in general all numbers have less digits in the duodecimal system.
2. The multiplication table is easier to learn in the new system with more repetition than in the decimal system. The table has only one three-digit number in the duodecimal system but eleven three-digit numbers in the decimal system.
3. The base of the duodecimal system has twice as many factors as the base of the decimal system. That is ½, ⅓, ¼, and ⅙ of 12 are all whole numbers while only ½ and ⅕ of 10 are whole numbers.
4. Corresponding to the decimal point we have a *more* convenient duodecimal point which gives an exact value for ⅓ and ⅑ which were repeated decimals in the former system. It also simplifies ¼ from $.25_{10}$ to $.3_{12}$ and ⅛ from $.125_{10}$ to $.16_{12}$.

5. Many practical problems are simplified, e.g.:

Find the area of a rectangle 4′-3″ long and 6′-7″ wide.

DECIMAL	DUODECIMAL
4·12 + 3 = 51″	(4.3′)(6.7′) = 23.£9 ft² or 23 ft² £9 in²
6·12 + 7 = 79″	1 Step
(51″)(79″) = 4029 in²	
4029/144 = 27 ft² 141 in²	
4 Steps	

DECIMAL	DUODECIMAL
Add 3 yrs. + 10 mos.	3.Ⅹ yrs.
2 yrs. + 5 mos.	2.5 yrs.
6 yrs. + 9 mos.	6.9 yrs.
5 yrs. + 8 mos.	5.8 yrs.
16 yrs. + 32 mos.	16.8 yrs. or 16 yrs. + 8 mos.
16 yrs. + 2 yrs. + 8 mos.	1 Step
18 yrs. + 8 mos.	
3 Steps	

In conclusion then the duodecimal system is less complex in both learning and application. It has many advantages and only one so-called disadvantage, namely it is a change and many people don't want to change. But then the current cumbersome denary system was opposed by narrow minded people who used the Roman numerals and who were too lazy to improve themselves. The better system eventually won out and so WILL DUODECIMALS.

J.M.J.

MARIST BROTHERS
ST. JOSEPH'S NOVITIATE
TYNGSBORO, MASS.

1169
5·17

» Dear Mr. Beard

Since last seeing you at the annual meeting a big change has taken place in my life. I have entered the religious community of the Marist Brothers a society of religious teachers that is worldwide. Right now I am in a period of religious preparation which will last until July of next year + so until that time I will not be active in any dozenal work. I will not be able to correspond with you — I had to get special permission for this letter.

The reason for this letter is the appearance of my article in the recent issue of the *Bulletin*. To say the least I was surprized when I discovered it. You know it's almost a year and half since I sent you the manuscript + I had all but forgotten you said you might publish it. I figured after you read it you figured it was too elementary for publication. One thing I noted up here in Mass. is that the students are much more open minded to the advantages of the 12 base. In St. John's most of the students looked upon it as a "crackpot" notion.

The *Bulletin* is very interesting one of the best yet but did you notice the cover? It says "Bibliography" from the last issue.

Thanking you for all you did in getting my article published (I appreciate it very much) + with a prayer for the success of all your work I remain, until next year,

Dozenally yours
Eugene J. Zirkel
MLD 12 19 MAY 53

P.S. Please send me about a dozen more copies if possible. Thanks again! *E.J.Z.*

COPY

91-16 211th Place,
Bellaire 8, L.I., N.Y.
December 7, 1953.

1169
10·7

Duodecimal Society of America,
20 Carlton Place,
Staten Island, N. Y.

» Gentlemen:

Please send a gift subscription for the *Duodecimal Bulletin* to Brother Louis Francis, Marist Brothers, Tyngsboro, Mass.

He was formerly Eugene J. Zirkel, of Bellaire, L.I., N. Y.

I am enclosing my check for $3.00.

Very truly yours,
George H. Zirkel

P.S. send gift card to me.

J.M.J.

MARIST COLLEGE
POUGHKEEPSIE, N.Y.

1169
6·26

June 26, 1175

» Dear Ralph,

I am teaching a course in modern mathematics here at Marist College this summer and one of the topics is the binary number system. I can't let this opportunity go by without injecting some doudecimals. Could you send me abot two dozen copies of the small brochure? I hope this finds you and yours well.

Sincerely,
Brother Louis Francis

J.M.J.

MARIAN COLLEGE
POUGHKEEPSIE, N.Y.

1167
9·5

September 5, 1954

» Dear Ralph,

It's been a long time since you heard of me, I know. During the past year I was sort of on the inactive list. I am now stationed at the above address, and I would appreciate it if you would forward the *Bulletin* to me. Have any of the issues been published? I don't recall receiving any since the one that contained my article.

If you recall quite some time ago I wrote to you and said that I was attempting to get another article on Duodecimals published in the *Mathazine*. Well I turned the manuscript in and then I left St. John's. Recently I received a copy of the *Mathazine* and to my great surprize they published two articles of mine, one of which is a brief outline of the Duodecimal circle. I have requested a copy be forwarded to you as I only have one copy myself.

This will be the last year that I can pay dues in the society. Last July I pronounced the vow of Poverty and from then on I can no longer possess any money. I will still appreciate any Duodecimal literature that you may send.

With a prayer for the success of your dozenal efforts, I remain sincerely yours,

B. Louis Francis, F.M.S

6 November 1954

» Dear Brother Louis Francis:

The one function of the Society that is meticulously performed is the free distribution of duodecimal literature.

We would be most grateful if you would inform Prof. Sarno at St. John's, that we would be happy to supply as much of our literature as he will find use for.

Recently we have been enjoying a notable increase in the number of requests we receive. It is stimulating to have our rather humdrum duties lightened by some shining

sign of growing interest.

We know the work is good, and we are grateful for any indication that we are being more effective in it. We ask to be stronger in the things we do well, and, especially more aware of the ways in which we fail.

Ralph H. Beard

Brother Louis Francis,
¢ Marist Brothers,
18 E. 81, N. Y. 25.

1170
7·3

3 October 1956

» Dear Brother Louis:

Your invitation to deliver a talk at St. Johns is a most gratifying development. Seeds sown in fruitful soil.

I have to disappoint you about the copies of the *Bulletin*, Vol. 9, №. 1. I have sent you a dozen copies, and that's all there are. So I have supported them with copies of Vol. ℰ, №. 2, which has the Herbert Spencer material. If there is any other material that you want, don't be reluctant to let me know.

I seem to be empty of ideas for the bones of the structure of your talk. These young people will want to hear from you three things, — (in addition to what duodecimals are, and what they do.) Are duodecimals enough better to justify a change? How is the change to be made? Have I, myself, any responsibility toward bringing it about?

I will try to give you some of my thoughts about the answers. We are faced with an actual necessity to change from our unintelligent and inadequate mix-up of weights and measures, and our educators are struggling to advance the change to the metric system. Why? Because it is stupid to have our weights and measures on scales of division different than our number base. But if we change to the metric measures, we lock-up our thinking in the grid of the ten-base so inescapably that we will forever be limited in our thinking by the awkwardness of that base in handling some of the most frequently used parts of things. No! The sensible thing to do is [convert] to the duodecimal system and secure all the advantages of an easy number system, and a familiar system of weights and measures with all its comfortable convenience. Moreover this system is so superior to the decimal that its adoption will render any other change forever unnecessary.

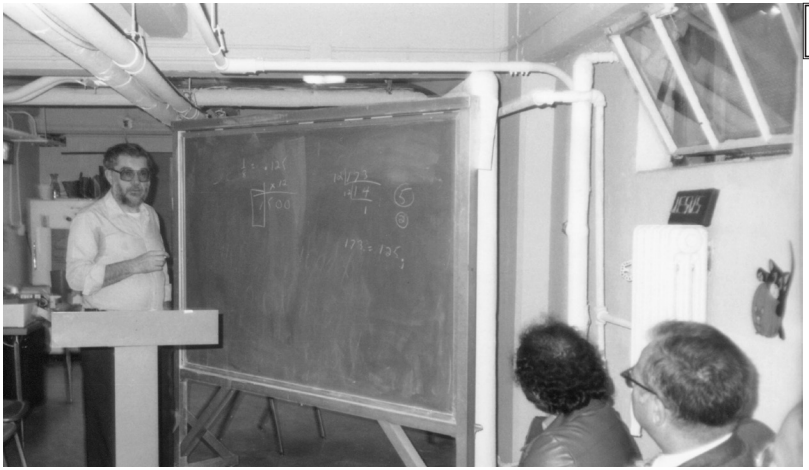
The change can only be accomplished by educating the public, — the housewife and the businessman, — into thinking in dozens and grosses, and into familiarity with the dozen numbers. This change can only be made through ease and familiarity; it cannot be made by compulsion. So we are faced with an imperative educational requirement, and on a huge scale.

Therefore, our first objective must be the positive conviction of our educators that this is the only right change, and that every effort must be made to align our educational system with this necessary change, — to bring it about as soon as we possibly can.

These approaches to answers make clear the field and the extent of our responsibility. We are responsible for the right use of what we know. And this applies for each one of us. With a clear concept of the ways in which duodecimals can facilitate all of our thinking, we have a positive power to convince others of the rightness of this stimulus to man's progress. And the range of the benefits of the order of the duodecimal system far surpass the bounds of the decimal system, which has been proven definitely limited in its application to some fields.

I hope tha t there is some help for you in the above. My own appraisal is that it could be much stronger. In this sort of case, we small people can only seek help. Herbert Spencer can help you some. But the source of all our strength is the best there is.

Cordially and gratefully,
Ralph



1183
7·13

Gene preaches about dozens at the Annual Meeting of 1983, to a pictured audience consisting of (left to right) Carmine De Santo, Walter Berkmann, and Tony Scordato. Gene was presenting mathematical precision and duodecimal fractions. See Vol. 29 №. 1 p. 11.

Mathematical Sophisms

by Brother Louis Francis, F. M. S.

A. One half of twelve is seven!
   Sure. The upper half. —XII—
B. But half a dodecagon has seven sides!
   Well, if you count the halving diagonal.
C. Nevertheless, half do two is seven.
   That's when we know how to do.
D. Yes, and sometimes half of xii does equal vii.
   Right. In Roman Dumerals.
E. And philosophically, half of twelve could be 7.
   Of course! If the other half were 5.
   There ought to be 7. But this is the other half.

Brother Louis Francis,
¢ Marist Brothers,
18 E. 81, N. Y. 28.

1171
1·13

15 January 1957

» Dear Brother Louis:

It is a deeply satisfying pleasure to send you the material to replenish your stock of duodecimal literature. This is good seed in fruitful ground. I would like to have heard your talk, and the interested response means that it was good.

Our Annual Meeting will occur on February 14th, at 8:30 at the Gramercy Park Hotel. It will be open to all of our friends, and the feature will be the presentation of the Annual Award to Jean Essig (in absentia.) A General Brison, Scientific Attache of the French Embassy will receive it for him, and there will be other notables present.

You and your friends are invited, and will receive another notice later on. We hope to see you.

Gratefully yours,
Whiskers {R. Beard}

Brother Louis Francis,
Aquinas High School,
1920 Highland Ave.,
Augusta, Ga,

1176
2·4

4 February 1962

» Dear Brother Louis:

It's just tough luck that you should be assigned to Augusta, Ga., before you got to Staten Island. But from any other viewpoint you must be quite happy. The climate of the Piedmont is widely praised, and you have the Savannah River at your front door. And your new charnge is quite a notable acknowledgement. We wish you every fulfillment.

We enjoyed your reminding us of your Dumerals, on which your paper was published in 1956 or 1957 in the *Bulletin*. The pleasant thing about them is that they get the message across cleanly, yet smilingly.

Gratefully yours,
Whiskers {R. Beard}

1176
5·4

May 4, 1962

» Dear Ralph:

Tonite you will attend our annual meeting. How I envy you. This is the first meeting I miss in 7 years, but be assured that I am there in spirit. I will certainly be looking forward to reading about it in the *Bulletin*.

I am enclosing a term paper written by one of my students. About four dozen boy wrote papers and several chose Duodecimals as their topic. This was the best. It was written without any propagandizing on my part. The boys read books (see his Bibliography) and wrote the papers. I answered their questions, but did not try to influence them. I was quite pleased with their conclusions. erhaps you might consider reprinting it in the *Bulletin*. You once told me that you liked to publish at least one elementary article in each issue.

After the papers were in, and I had finished the required topics for the year, I did teach the boys Dozenal counting and its advantages. The were an advanced class and I met lots of opposition and plenty of questions. It was a real challenge for me, but it was good. It made me rethink and re-explain some of my arguments. In the long run I think I converted them (except one die hard proponent of the metric system) to at least see the advantages of the system, even if some of them belong to the school that feels the change over is too dif ficult.

If you don't want the term paper, please return it to me eventually. NO RUSH. I will be teaching at Marist College again this summer. I will teach the second half of the course I taught last year. You will recall that included several lectures on twelve base counting. My address will be at Marist College, Poughkeepsie, N.Y. until August 22.

Sincerely,
Brother Louis

Ralph Herbert Beard 1890 1974

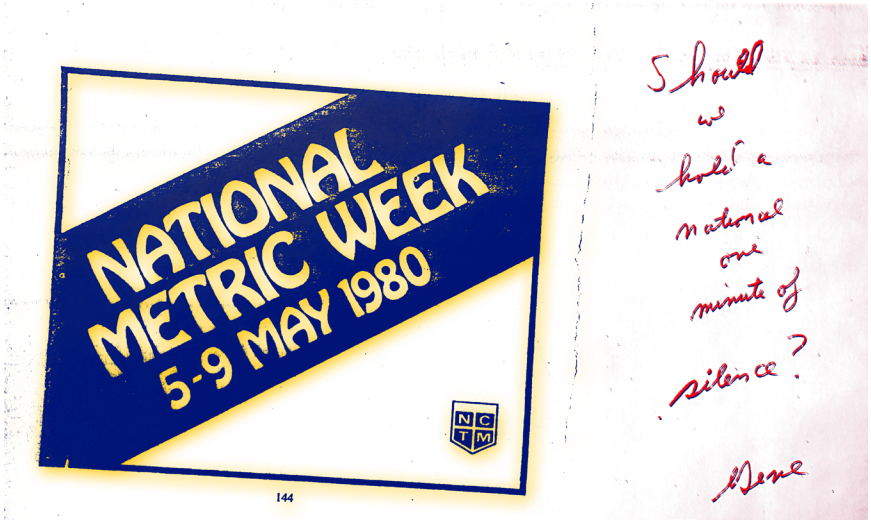
Reprinted
Vol 26 No 1 p. 18

by F. EMERSON ANDREWS

Early in the morning of October 7 Ralph Beard was driving on Florida Route 90 on his way to the annual meeting of the Duodecimal Society in Jacksonville. About 35 miles north of that city he collided with a Trailways bus. There were massive internal injuries and cranial damage; death was probably instantaneous. Mr. Beard would have been 84 three days later, on October 10. His car was demolished. There were no injuries requiring hospitalization on the part of the bus driver or the passengers. …

Born in York, Pennsylvania in 1890, Mr. Beard spent most of his business life with the New York Telephone Company, where he was a telephone service engineer.

A sizeable legacy was left to the DSA under the terms of Beard's will.



Joke From a 17 December 1190 letter to DSA President Tom Linton.

QUESTION: What is the area code for the fabled "city of gold"?

ANSWER: #0√0

PRESS RELEASE MAY 1190;

A meeting of the leaders of the Dozenal Societies of Great Britain and America was held recently (5 May 1190;) at Nassau Community College, Garden City, Long Island, New York.

This coincided with the opening of the Dozenal Collection now housed at the college library. This collection of books, periodicals and pamphlets was previously kept in the homes of various officers of the group. Now it has a permanent home due to the efforts of President Tom Linton, Professor Gene Zirkel, and Librarian Rita Morris.

Efforts at greater unity between the national Dozenal Societies of Great Britain, the United States, and Canada and New Zealand were discussed. Especially important was the merging of the journals of the British and American groups. *The Duodecimal Bulletin* has been published in the U.S. since 1160; (1944). Under the new plan agreed to by Arthur Whillock, representative of the British group, their *Journal* will absorb the American magazine, and they will delete the words "of Great Britain" from their title. This first step towards an international society reflect the increased interest in Dozenal counting since Great Britain and the U.S. have taken tentative steps toward the awkward decimal metric system.

At the same meeting, Professor James Malone of N.C.C. was elected treasurer of the American Group. Professor Malone is also coordinating plans for the Annual Meeting to be held this fall [Saturday September 6] at Boulder, Colorado.

Professor Gene Zirkel

NATIONAL METRIC WEEK

You are invited to attend the 31;st (37TH)
Annual Meeting of the Dozenal Society of America
at Nassau Community College, Garden City, LI, NY 11530
Friday May 8 to Sunday May ℵ, 1191; (1981)

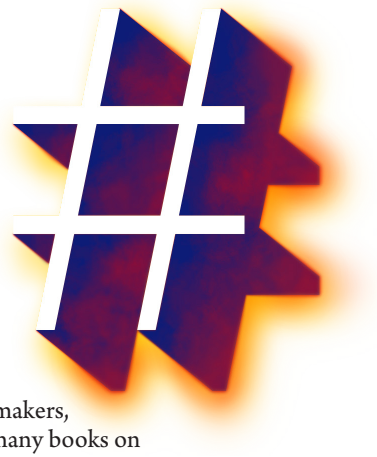
THEME: Prepare yourself for National Metric Week
— investigate the Twelve based metric system

OPEN MEETING: Saturday afternoon, May 9th at 2PM. All are cordially invited. Of special interest to students of all ages, teachers, and anyone interested in learning about counting in bases other than ten. Come and meet with engineers and laymen — people interested in a simplified method of arithmetic.

For further information contact
Prof Gene Zirkel
Prof Jim Malone
Prof Tony Scordato

What's in a Name?

(GENE ZIRKEL)



At the annual meeting in NY in 1979, our then Vice President, Henry Churchman, spoke about the new symbols that the telephone companies had added to their instruments, namely * and #. We all knew that the former was named an asterisk, but no one could name the latter. We knew of its *uses* as a pound sign, a number sign, a musical sharp, and a proofreader's space, but none of us could *name* it.

Intrigued by this, I began what was to become years of research. I contacted the telephone company, music houses, printers, crossword puzzle editors, map makers, and etymologists. I looked in various dictionaries and many books on symbols. Nothing!

Now, finally, through the help of a friend who works for the telephone company, I have found it. It is called an *Octothorpe*. All the telephone companies seem to use this term with the exception of NY Telephone (which uses no name at all); and you have just joined the small percentage of people who know this name.

The next question of course is *Why* "octothorpe"? "Octo" means eight, and "thorpe" means village. The eight probably refers to the eight lines extending from the central quadrilateral. But "thorpe"???

Reprinted Vol 26 No 1 p. 22 → *Gene Zirkel*

Ed. Note:

These days,
we call it a hashtag.

Joke [EL-DO RAD OH]

Nationwide Coverage

1192
5.13
Reprinted
Vol 27 No 2 pp. 9, 25

It was reporter Irene Virag who started the ball rolling. Her editor had given her the assignment of covering our Annual Meeting, and after two phone conversations she decided to attend the Saturday afternoon session. At first she just sat and listened, then she began to interview those present. On the following day, Sunday, May 16th, her article appeared on page 19 of *Newsday*, Long Island's largest newspaper. HEADLINED: "Group Says Counting's Better by the Dozen", the well-written piece talked about dozens of eggs, inches, months, etc., and included this reference to the decimal metric system: "It's a good idea to measure and count the same way, but not by ten."

Her report was then sent out over the Los Angeles *Times*, Washington *Post* News Service and was printed by a number of newspapers. The following are those of which we have heard: The San Francisco *Chronicle*, The Des Moines *Register* (page one!) The Toronto *Star*, The Vancouver *Sun*, The Atlantic City (NJ) *Sunday Press*, The Cleveland *Plain Dealer*, The Middletown (CT) *Press*, and *The Globe* (a nationwide newspaper sold in supermarkets). In less than a dozen days we received mail and phone calls from Reno, Nevada; Hinckley, Ohio; Wildwood Crest, New Jersey; and Los Angeles, California.

In addition, I have been interviewed three times with reference to the wire-service article. Both John Picton of the Toronto *Star* and Nancy Bolick of *The Globe* called for additional information and wrote their own articles (which have since appeared in their respective publications). I was also heard live on station KHGZ (97 FM) in Los Angeles at 8 a.m. on Wednesday, May 26th.

The publicity netted us many requests for additional information and several new members. We owe a debt of gratitude to Ms. Virag for her well-balanced report of our activities.

1986 Pulitzer prize-winning reporter Irene Virag wrote an article covering the 1982 Annual Meeting on page 19 of Long Island's Newsday newspaper. This triggered an avalanche of publicity for the DSA across North America that year.

LONG ISLAND DIARY

Where Dozen Is Not a Dirty Word

By Irene Virag
STAFF WRITER

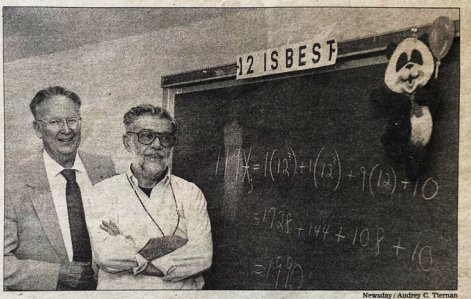
The room number of the headquarters of the Dozenal Society of America makes the point. — A-12. So does the sign on the door of the office at Nassau County Community College, "12 is Better." And the paper panda below it is an appropriate addition. The panda is the society's mascot for a very simple reason. Pandas have six digits on each leg — their toes are divisible by 12.

Gene Zirkel, a former Marist brother turned math and computer science professor, thumbs through a copy of the most recent issue of The Duodecimal Bulletin, the society's quarterly journal. Gene Zirkel is the chairman of the board of the Dozenal Society of America and he'd love it if his toes were divisible by 12. In his view, the fact that they're not has thrown the world off base. Humans went astray when they started counting on their fingers — they got up to 10 and ran out of digits. In his own way, Gene Zirkel is trying to put the world on its proper base — base 12, to be exact.

So is Fred Newhall, who reads a past issue of the journal that features the floor plan of "The Dozenal House." Fred knows every inch of the house — he built it almost three dozen years ago in Smithtown with his own 10 fingers. Each room is a 12-foot square; and the hallways, the garage and the bathrooms are measured in fractions of 12. Even the round swimming pool in the backyard is divisible by 12; its circumference is exactly 36 feet. Fred, a retired electrical engineer, is at a perfect age to enjoy his tenure as president of the society. He's 72, or as he prefers to count the years: "I'm an even six dozen."

Both men have dozens of facts at their fingertips — insufficient as they may be. What they all come down to is that the way we count simply doesn't measure up. The point here being that we've always measured by twelves: there are 12 inches in a foot, 12 months in a year, 12 notes to an octave.

"It was a simple biological accident that made us think 10 was so handy," Gene Zirkel says, waving his digits to emphasize the point. "Once you train yourself to think in twelves, life — and math — get easier."



Newsday / Audrey C. Tiernan

Newhall, left, and Zirkel at blackboard with 1990 written in base 12 system

is trying to do. The dozenals have banished 10 from their vocabulary. Instead, 10 is called *dek* and designated by an asterisk, *. Eleven is called *el* and designated by an octothorpe, #. The magic number twelve is called *do* — pronounced dough — for dozen and written as 10. But don't get confused, that's not 10. It is simply 1 dozen plus zero. Other essential units in the dozenal system are a gross, known as *gro*, which is 12-squared, or 144, and a *mo*, which is 12-cubed or 1,728.

So when Gene Zirkel tells you that his age is "Four Do Dek," he's saying 58, of course. And when he tells you that the year is "One Mo, One Gro, Nine Do, Dek" that's just as obvious — it's 1,728 plus 144 plus 108 plus 10. *Voila*, 1,990.

And when Fred Newhall says that the base-12 to be dropped."

The society, which charges a $12 membership fee, was founded in 1944. But thinking in twelves goes back dozens of centuries. Gene Zirkel and Fred Newhall have evidence that it divided thinkers as long ago as the 1500s. Later, no less an absolute authority than Napoleon supported dozenal theory. "Twelve has always been preferred to ten as a divisor," said the emperor. "I can understand the twelfth part of an inch, but not the thousandth part of a meter." And in 1821 — or just about two dozen years more than a gro ago — John Quincy Adams wrote, "Nature has no partialities for the number ten, and the attempt to shackle her freedom with it will forever prove abortive."

Even today, the dozenals are in pursuit of [illegible]

A copy of the article appears in the Dozenal Library which currently is hosted in St. Louis, Missouri.

NOT ENOUGH FACTORS

Duodecimal Bulletin WN 62; Vol. 32; №. 2 of summer 1199; featured an article titled "10;0 = One Dozen", *Missouri Council of Teachers of Mathematics Bulletin* Vol. XIV, №. 3, reprinted with permission from the Council. Gene Zirkel assisted with the article.

One of the council's reporters became enthusiastic with the aims of the Dozenal Society and began advocating for conversion to the dozenal system. We present a couple quotes from the article.

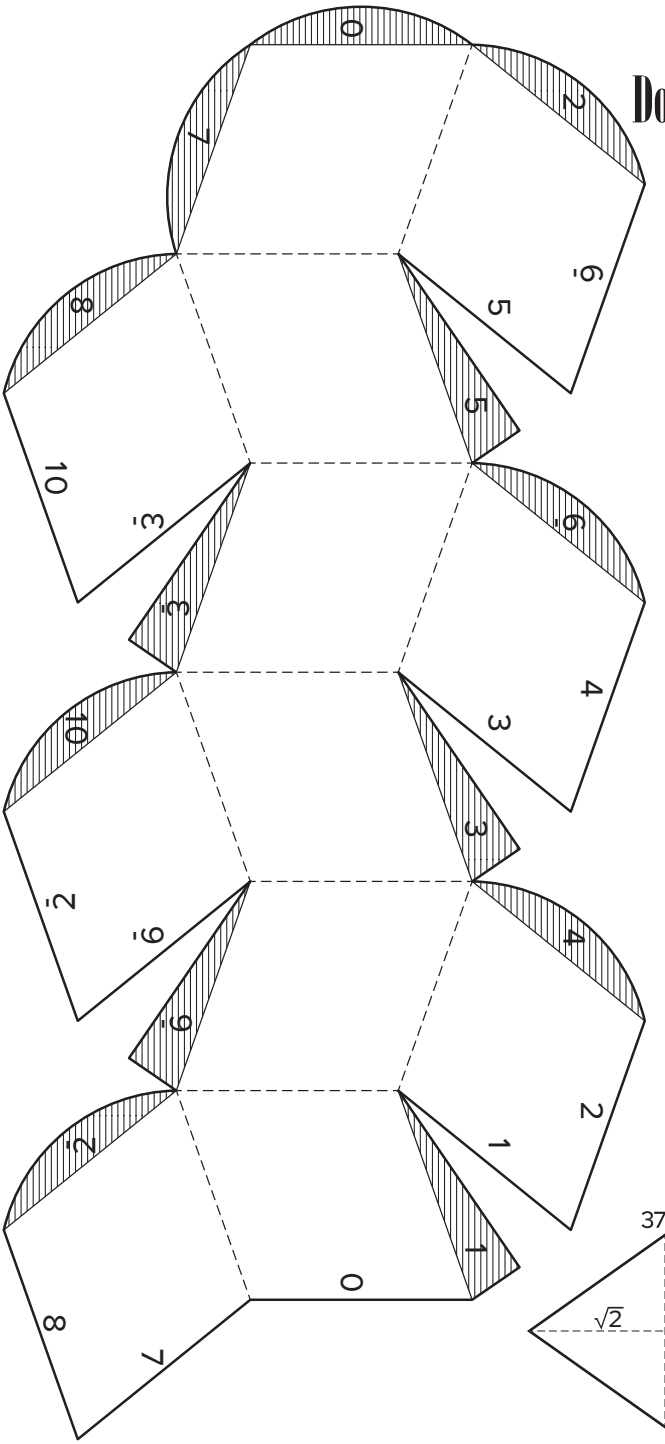
"Mathematicians and philosophers have long been aware that ten is actually a poor base for a number system. Several others have been suggested, with considerable agreement that twelve, with its many factors, would be the most serviceable. Its actual use has been suggested at various times, notably by Herbert Spencer and Isaac Pitman—but the hand of tradition is heavy, and few persons, even among professional mathematicians have actually tried out this superior system of counting by dozens."

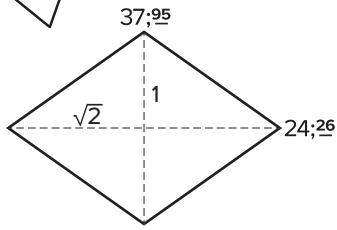
"The decimal base is unsatisFACTORY

because it has NOT ENOUGH FACTORS."

Make your own

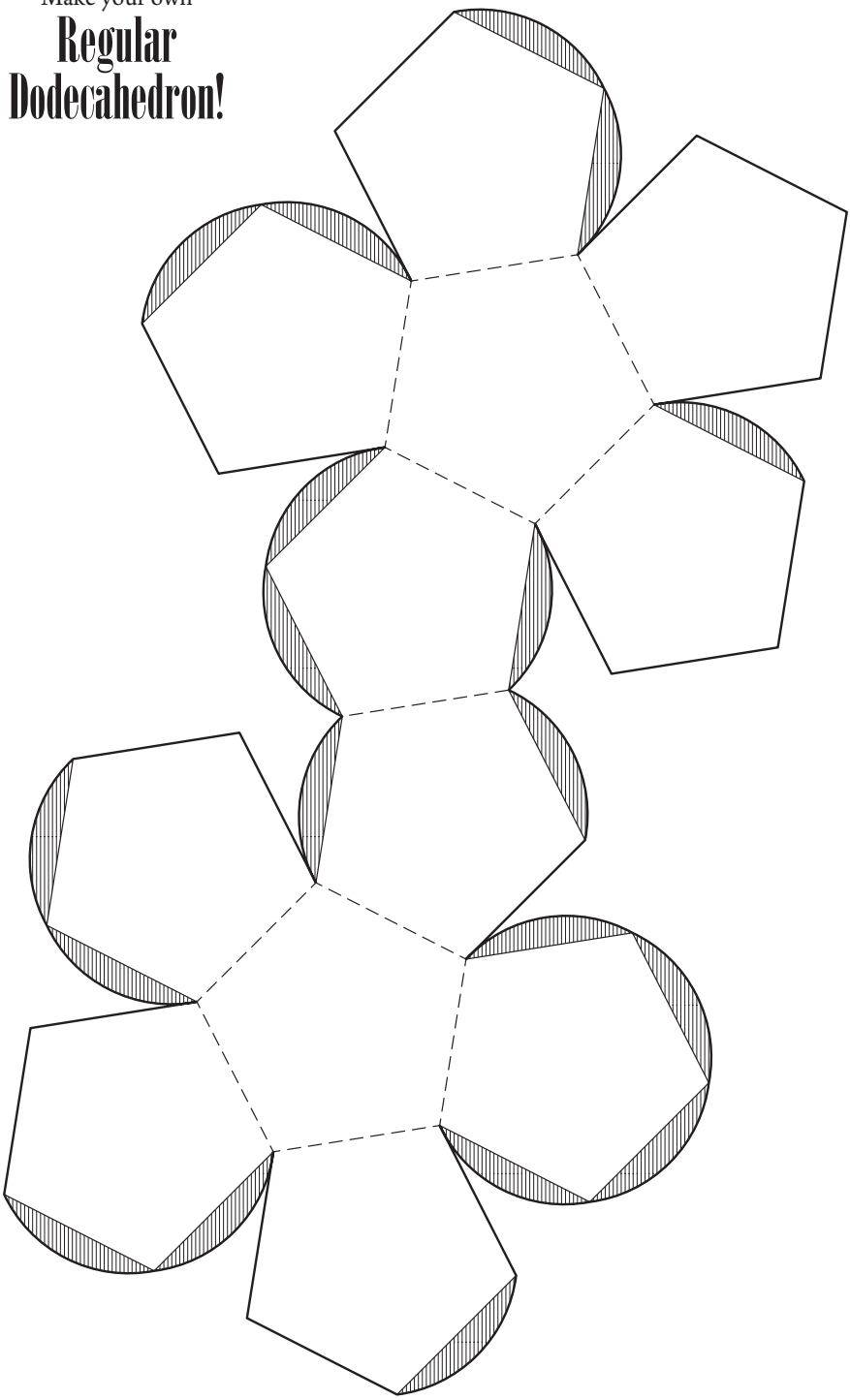
Rhombic Dodecahedron!





Make your own

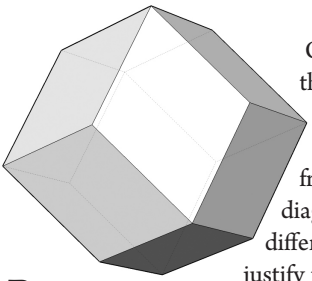
Regular Dodecahedron!



The Regular & Rhombic Dodecahedron.

by Michael D^{e} Vlieger

The number twelve is the product of the smallest prime applied twice and the second smallest prime, 2, 2, and 3. From this, the flexible divisibility of this compact number and the brevity of its expression of the natural fractions ¼, ⅓ , ½ ,⅔ , and ¾ arises. Duodecimal multiplication is richly patterned for all the divisors that it has.



Rhombic

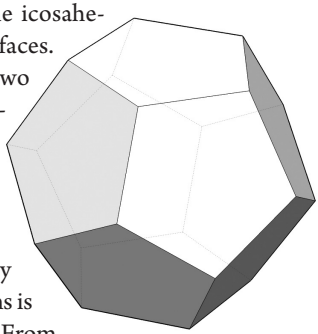
Dozens and Geometry.

Geometry also heralds the number twelve, mainly through symmetry. We know that we might bring together the simplest regular polygons (i.e., the square and the equilateral triangle). We can bisect the triangle from vertex perpendicularly to opposing side, and square diagonally to derive the angles 30°, 45°, 60°, and 90°. The difference of 15° between the first two figures allows us to justify them in integers by using a unit circle divided into two dozen parts. (Cf. "Validating a Dozenal Measure of Angle", *Duodecimal Bulletin* wn Ↄ0, 11Ɛ7 (2011.), 11–16.)

Going beyond this, we focus on two three-dimensional regular polyhedra with twelve uniform sides, one a regular Platonic solid, the other described by Johannes Kepler.

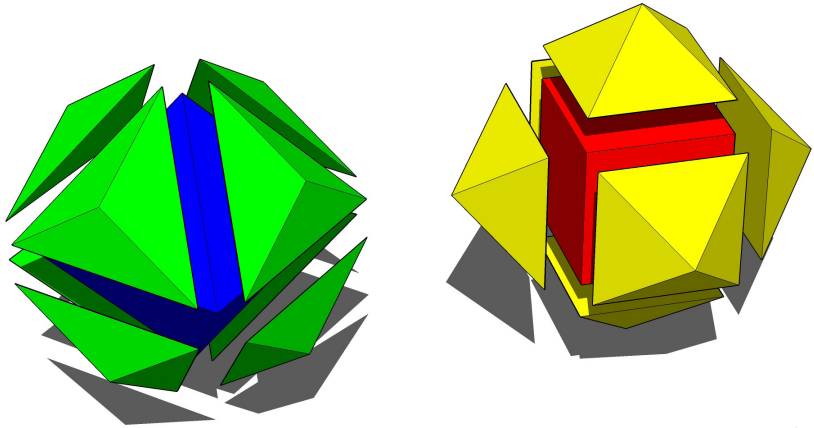
The Regular Dodecahedron.

Dodecaphiles might be familiar with the "12-sided die" or the regular dodecahedron of a dozen pentagons, three to a vertex. This figure is the "dual" of the one dozen eight-sided icosahedron, meaning we can transform the icosahedron into a dodecahedron by replacing its points with faces. The icosahedron has one dozen eight triangular faces, two dozen six edges, and a dozen vertices, while the dodecahedron has a dozen pentagonal faces, two dozen six edges, and one dozen eight vertices. The regular dodecahedron is one of the 5 Platonic solids, known to Aristotle in ancient Greece.



Regular

According to Cromwell, the Greeks likely were taken by the Platonic solids because the number of regular polygons is infinite, yet there are only 5 regular (convex) polyhedra. From all but the icosahedron, we can build 6 regular polychora in 4 dimensional space, but in space greater than the fourth dimension, we only have 3 regular *n*-dimensional figures. These are the "simplex", "measure", and "cross" polytopes analogous to the tetrahedron, cube, and octahedron, respectively. The "extra" figure in 4-space is a second self-dual figure. We have the self-dual tetrahedron in 3-space; replace vertices with faces and we merely remake the tetrahedron. In 4-space we have the self-dual icositetrachoron of two-dozen octahedral cells. We will relate the tesseract (the 4d analog to the cube) and the icositetrachoron to the second kind of dodecahedron.



Two methods of building a rhombic dodecahedron. We can use an octahedron with 2 tetrahedra (left) or 2 cubes (right). We mount the radially-cut facets of the tetrahedra or second cube and mount them on the surface of the octahedron or cube respectively.

The Rhombic Dodecahedron.

The second kind of twelve-sided uniform polyhedron has faces in the shape of the *rhombus*, a 4-sided (quadrilateral) 2d shape whose edges have the same length but whose angles are not necessarily the same. This figure is described as "uniform" rather than "regular" because the rhombus is not a regular polygon; for this reason, this polyhedron is not considered one of the Platonic 5.

Johannes Kepler discovered the rhombic dodecahedron. "Kepler knew two examples of his half-regular polyhedra. The first is bounded by twelve rhombi whose diagonals are in the ratio of $1:\sqrt{2}$." (The second has two dozen six of the same shapes.) Kepler mused on these uniform solids in a letter called *De Nive Sexangula*, written in 1611. In this letter, he mentions a relationship between the rhombic dodecahedron and both the cube and (regular) octahedron, duals of one another.

We find the rhombic dodecahedron in nature since it arises from a body-centric division of the cube. Suppose we divide a cube into six identical square-pyramidal pieces that consist of one of its square faces, and new faces produced by joining each of the vertices of the square to the center of the original cube. If we mount each of these pyramids to each of the six square faces of a second cube, we produce a rhombic dodecadedron. From this shape, we note that the shorter diagonals of all the faces of the rhombic dodecahedron comprise the 12 edges of the cube. We can take the perpendicular, longer diagonals of the polar rhombi to construct a regular octahedron, the dual of the cube. The figure appears in nature. The mineral calcite is a crystal that exhibits rhombic dodecahedral geometry. We can produce a rhombic dodecahedron by cleaving the mineral. This was a 1784 discovery by the "Father of Crystallography," René Haüy.

Since the octahedron with its 8 equilateral triangular faces is the "dual" of the cube, we can also construct the rhombic dodecahedron with an octahedron and two tetrahedra split into triangular pyramids. The triangular pyramids are achieved similarly to the aforementioned square pyramids, by joining the triangular face's vertices to the center of the tetrahedron. We mount the 8 pieces (4 for each tetrahedron) onto the triangular

faces of the octahedron. We observe that we can fill 3-space with octahedra and tetrahedra such that we produce a rhombic dodecahedron at the center points of the tetrahedra.

We can construct the rhombic dodecahedron as the "convex hull" of the overlain duals. A convex hull is a shape described by joining the vertices of the cube and octahedron such that we produce a convex polyhedron.

In the observation of rhombic-dodecahedral symmetry as regards calcite crystals, we note that the figure can be approximated by stacking a progressively smaller square of unit cubes in levels on each face of a cube. The number of cubes in this "Haüy construction", given a large central cube of n smaller unit cubes appears in OEIS A046142.

The rhombic dodecahedron is also a projection of the tesseract, a four-dimensional analog of the cube produced by sweeping a unit cube one unit in a direction perpendicular to all the three stereo directions. Further, the rhombic dodecahedron is related to the icositetrachoron, a self-dual four-dimensional regular polychoron possessing two dozen regular octahedral cells. It is the vertex-first projection of the icositetrachoron, but further, the method of constructing the icositetrachoron from two tesseracts is directly analogous to the method described here to produce the rhombic dodecahedron.

Plato conceived of the structure of the universe as having a structure of nested regular polyhedra. Each polyhedron represented an element; tetrahedrons fire, cubes earth, octahedrons air, icosahedrons water, and dodecahedrons the quintessence or the fabric of the cosmos. In our modern year, we might be led to think of these nested shapes being the manifold of the cosmos as an obviously outdated concept. In 2003, publications such as Nature and Physics Today pondered a dodecahedral symmetry to the universe, specifically that of Henri Poincaré. This geometry is related to the 120-fold dodecaplex (a 4 dimensional regular polyhedron). Instruments like WMAP seemed to support the idea in 11ᘔ8; (2008.), however the European Space Agency's more recent Planck observatory analysis suggests no non-trivial support for any such geometry.

It's fairly easy to construct your own model of the rhombic dodecahedron, thanks to the pattern on page 1ᘔ. Using rhombuses whose diagonals have a ratio of $1:\sqrt{2}$ and joining them such that the acute angles come to a point with 4 rhombi to a vertex, and the obtuse angles join 3 to a point, we can produce the twelve-sided object. The pattern for a model of the regular dodecahedron appears on page 20.

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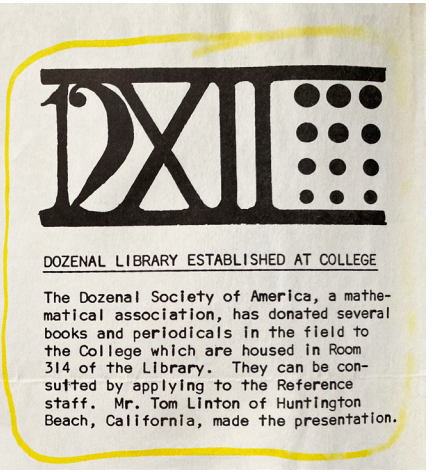
***Above**: Gene Zirkel, Jim Malone №. 42, Tony Glaser, and Henry Webber, at the 1979 Annual Meeting at Nassau Community College. See Vol. 27 №. 3 p. 21.*



DOZENAL LIBRARY ESTABLISHED AT COLLEGE

The Dozenal Society of America, a mathematical association, has donated several books and periodicals in the field to the College which are housed in Room 314 of the Library. They can be consulted by applying to the Reference staff. Mr. Tom Linton of Huntington Beach, California, made the presentation.

***Right**: Announcement of the Dozenal Library in Nassau Community College's Library Newsletter Vol. xv, №. 3, Summer 1190.*

1190
5·9

Seated at Holiday Inn Hempstead following the international special meeting of 1980, from left to right, Ruby Whillock, Dudley George, Gene Zirkel, Patricia Zirkel. See Vol. 28 №. 1 p. 10.

DEDICATION | THE F. EMERSON ANDREWS MEMORIAL COLLECTION

1198
3·17

Reprinted
Vol 31 No 2 pp. 14-15

March 19, 1988 (17; March, 1198;)

Library • Nassau Community College • Garden City, LI, NY

At the 1987 DSA Annual Meeting, the Society passed a resolution to the effect that the Dozenal collection of materials and books which are housed in the Nassau Community College Library be dedicated to the memory of DSA Founder F. Emerson Andrews. Many of these materials were in fact written by Mr. Andrews.

On March 19, 1988 the materials were dedicated as the "F. Emerson Andrews Memorial Collection", and a plaque attesting to this and to the fact that these materials were donated to the Nassau Community College Library by the DSA was unveiled. Many members of the Society were present, along with Edith Andrews (Mrs. F. Emerson), and other members of her family.

Following the dedication, Mrs. Andrews said: "The assembling of Emerson's mathematical writings constitute an accomplishment worthy of its own tribute to (the Society) … It is good to know that there is a memorial collection, safely housed in a college library. Emerson would be pleased, and proud, as are our sons and I."

The Society is grateful to Dr. Angelo Scordato who was responsible for the organization of the event. Tony is the Chair of the Awards Committee which first proposed the naming of the Library's Dozenal collection. He was also in charge of arranging for the obtaining and mounting of the dedication plaque.

LEFT: Then-president Gene Zirkel (left) with Nassau Community College President Sean Fanelli. The Dedication Plaque, showing the Seal of the DSA, is shown mounted on the door of the room in which the collection is housed. ***RIGHT:*** *Gene at right is in the process of clearing out the home of the collection 25 June 2011, speaking with Prof. Jay Schiffman. A concentrated portion of the collection is currently in St. Louis at the office of Michael De Vlieger, current DSA secretary.*

ROMAN DVMERALS

by Brother Louis Francis, FMS.
aka Gene Zirkel

Reprinted
Vol 10 No 1 pp. 7-9

When the Arabic notation was introduced into Europe around the year 1000 AD, it was applied, without thinking, to the base ten. If at that time the Western World had been counting in the more logical twelve base, there would be no need for the existence of our Society today. (Obviously, if our predecessors had been intelligent enough to count by dozens before the introduction of the place system they would also have been intelligent enough to see the advantages of each system and would have combined the Arabic notation with the Twelve base.)

Let us investigate these historical Might-have-beens, these Roman DUMERALS (Roman numerals to the base Twelve.)

	Roman Numerals		Roman Dumerals	
I	one	unit	one	**i**
V	five	½ base	six	**v**
X	ten	base	do	**x**
L	fifty	½ base squared	six do	**l**
C	one hundred	base squared	gro	**c**
D	five hundred	½ base cubed	six gro	**d**
M	one thousand	base cubed	one mo	**m**

Thus we would count in dumerals:

i, ii, iii, iiv, iv, v, vi, vii, viii, iix, ix, x, etc.

Conversion: In order to convert numerals to dumerals and vice-versa, we set up the following conversion tables:

Table A

Numerals	Dumerals
I	**i**
V	**iv**
X	**iix**
L	**xxxxii**
C	**lxxiiv**
D	**cccxlvii**
M	**dxciiii**

Table B

Dumerals	Numerals
i	I
v	VI
x	XII
l	LXXII
c	CXLIV
d	DCCCLXIV
m	MDCCXXVIII

To convert a numeral, for example MCMLIV (1954), to a dumeral we proceed as follows:

1. Separate the positive symbols from the negative.

Positive	Negative
MMLV	CI

2. Convert each symbol individually into its dumeral values as found in Table A:

Positive		Negative	
Numerals	Dumerals	Numerals	Dumerals
M	**dxciiii**	C	**lxxiiv**
M	**dxciiii**	I	**i**
L	**xxxxii**		
V	**iv**		

3. Separate these dumerals into positive and negative symbols as shown below:

dciiii			**lxxv**
dciiii			**i**
xxxxii			
v	②	①	
	③	④	
x			**ii**
x			**.**
.			
i			

4. For convenience we number each set of dumerals as the quadrants in Cartesian Geometry. Then we can cancel the dumerals in any odd numbered quadrant. In our example we cancel:

   the **xxi** in quadrant ③ with an **xxi** in quadrant ②;
   the **i** in quadrant ① with an **i** in quadrant ④;
   the **xxv** in quadrant ① with **xxv** in quadrant ②, etc.

   The purpose of this cancellation is to remove all the dumerals from quadrants ① and ③ (the negative symbols).

5. However, we still have one **i** in quadrant ① so we subtract it from a **c** in quadrant ②, and put down the difference, namely **l**.

6. Now we combine the dumerals in quadrants ② and ④ (the positive symbols) and writing them in order of magnitude we get:

   dd c l iii iii iii i

7. The final step is to simplify the dumeral into the following:

   mcliix

   which gives us 116*χ*, the Duodecimal equivalent of 1954.

To convert dumerals to numerals the same procedure is followed, substituting from Table B instead of Table A.

In actual practice it is not necessary to go through this method for every numeral we wish to change. Often it will be found easier to mentally break the number into dozens and then convert it. For example:

XVII = one dozen five = **xiv**
LVI = four dozen eight = **xxxviii**
CIX = nine dozen one = **lxxxi**

The only drawback in this system is that it has no advantages over ordinary base ten numerals. All systems of this type are equally poor for mathematical uses and especially for computation. Why, if we put dumerals on the face of a clock, instead of less symbols we would actually need one more than if we were to use numerals! And so, with no advantages save those to be gained after the adoption of Arabic numerals, it is no surprise that the Romans would have resisted the introduction of a new base with the then-unanswerable query, "Why change?"

In Memoriam

Henry Clarence Churchman

1172

Reprinted
Vol 37 No 1 pp. 1X

Editor · President · Board Member · Inspiration

Gene Zirkel

When we first met Henry Clarence Churchman, his courtly ways moved my wife to describe him as the perfect "Southern Gentleman". Actually, Henry was from the midwest, but his cheerful politeness endeared him to all of us who knew him.

Member number 72;—there are only one and a half dozen two-digit members still on our mailing list — Henry joined our Society in 1952.

A stalwart of the DSA, Henry was elected vice president at Alamogordo, New Mexico in 1962, and he held that position until 1971. In 1970, he took on the additional responsibility of editing our Bulletin, and he served in that capacity until 1978. Along the way he guided the DSA during his three terms as president beginning in 1971.

In 1976, while still editor, he again took on the responsibilities of vice president, a position he held until illness forced him to retire in 1981.

In 1980, our Society honored him, bestowing upon him our annual award. It has never gone to a more deserving honoree.

Always an active member of the DSA and an ardent proponent of duodecimals, he wrote many articles under both his own name and several pseudonyms. We discovered this latter fact upon going thru his papers.

In President Fred Newhall's comprehensive index, Henry has one of the longer entries: a dozen and a half lines of references. In addition John Jarndyce has a line and a half containing five additional articles and Egbert Pardiggle also has a line and a half with four more. (This latter alias indicates the sense of humor Henry brought to everything he did.)

In 1981, he was too ill to continue his work, and my wife Pat, my son George who was dek years old, and I traveled to Iowa to collect our Society's archives and Henry's papers. His son, John, graciously helped us pack dozens of cartons which we shipped to Nassau Community College.

Henry was an active lawyer, involved in many things. Henry was always a man ahead of his times.

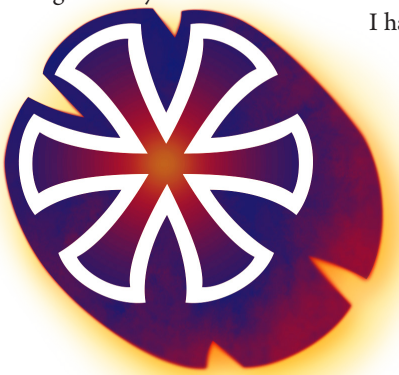
We miss him as a friend and an inspiration to dozenalists everywhere.

Origins of Asterisk and Octothorpe

Gene Zirkel · Nassau Community College · Garden City, LI, NY

Reprinted
Vol 36 No 2 pp. 15-16

Which symbols to use has always been a bone of contention among advocates of dozenal counting. Some favor using the current 0 through 9 plus two additional symbols for ten and eleven. Others prefer a completely new set of digits. Even among those who agree on one or the other of the above ideas, there is a great deal of disagreement concerning which symbols should be used.



I have always been of the school that advocates only for adding two new symbols, and I really don't have strong feelings as to what they may be. I think that we gain more converts at this time by keeping the familiar digits from 0 to 9. I also feel that when dozenals are finally accepted, society will decide on what symbols it then wants, not the DSA.

In the interim, I can use any two symbols that we agree upon, as long as they do a reasonable job of signifying ten and eleven. The DSA long used the script ↊ and ↋ designed for us by the typographer, Dwiggins. When the telephone company introduced the dozenal push-button phone, it was decided to switch to their asterisk (*) and octothorpe (#) because it was felt that these would become familiar to many people.

The DSA does not endorse any particular symbols, but for the sake of uniformity, and to make it easier on our readers — especially newcomers — the editors of our Bulletin have always adhered to the following policy:

Unless an article was about symbols, the Bulletin would use the same symbols in all articles. In earlier issues, these were the symbols designed by Dwiggins and now they are ↊ and ↋.

Our British cousins in the DSGB have adopted the rotated 2 and 3 (↻ and ↋) which were first suggested by Sir Issac Pitman, the inventor of Pitman Shorthand. Some of their members have suggested that we should all use the same symbols. I do not see any advantage to the DSA making another change of symbols at this time. (I sometimes regret that we abandoned Dwiggins.) One pair of symbols is just as good as another, and further change might tend to confuse our readers and make us appear inconsistent. The rotated 2 and 3 are not on standard typewriters nor computer printers, while * and # (or X and E) are readily available.

Recently, Honorary Member number 262; Arthur Whillock or Great Britain indicated that the first use of the * and the # was by Edna E. Kramer. Following his lead, I found her book in the Nassau Community College Library:

Edna E. Kramer, *The Main Stream of Mathematics*, New York, Oxford University Press, 1955 [Fourth Printing 1963], pages 16 and 17. [ISBN 978-0945726012]

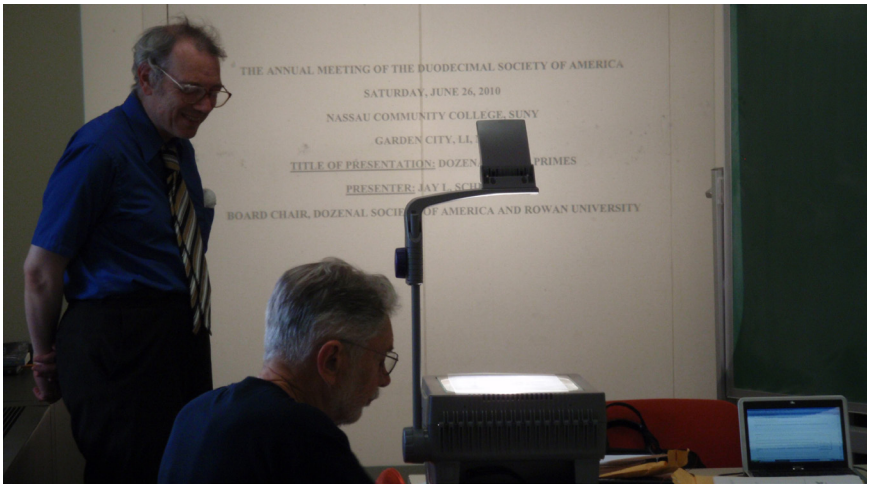
She uses * and # without naming them. Kramer mentions that some mathematicians have agreed that twelve would be the best base since it has divisors 2, 3, 4, 6, which

would have made fractional work easier than it is in base ten. The author, however, remains neutral on the subject.

In addition she makes reference to the story that King Charles XII (what else?) of Sweden was about to mandate duodecimals when he died [This story is apocryphal. See this *Bulletin*, Number 52; Vol. 2Ƹ, No. 3, Fall 1985, p. 17; -Ed.]

Giving credit where credit is due, perhaps we should refer to Kramer's * and #, rather than to the telephone company's.

Over the years, the origin of dek and el, the asterisk and octothorpe symbols, were a sort of holy grail for Gene and the subject of his intensive research.



Gene mans the overhead projector during Prof. Jay Schiffman's dozenal home primes presentation during the Annual Meeting at Nassau Community College, 26 June 2010. 11Ɛ6 6·22

Gene awaits Member Dan Simon's answer to a mathematical query during the Annual Meeting at Nassau Community College, 27 July 2012. 11Ɛ8 7·23

My Tribute to Professor Gene Zirkel:

A TRUE DOZENAL LEGEND

Board Chair Jay L. Schiffman

In 1160 (1944.), The Dozenal Society of America was chartered in Staten Island, NY and was the brainchild of several pioneers, notably Frank Emerson Andrews, F. Howard Seely, Ralph Beard, George Terry, and Henry Churchman. The modest goal was to educate the general populace on the advantages of the base twelve system of numeration in counting, measurement as well as in pure and applied science. Our first bulletin became a reality in 1161 (1945.) and the beginning of a new era of thinking ensued. The presence of dozens is readily apparent as one navigates their everyday lives. While dozenal enthusiasts will be eternally grateful for these pioneers, it is beyond debate that both the glue and the goodwill ambassador for our organization for five and one-half decades was none other than Eugene (Gene) Zirkel. Gene wore numerous hats in our society including President, Vice President, reviewer of articles for the *Bulletin* and Board Chair as well as being a prodigious contributor to our *Bulletin*. His numerous contributions as well as a celebration of a life well lived serves as the focus of the current issue.

Gene's introduction to dozens began modestly enough as a class project in an undergraduate Topics in Mathematics class taught by Professor Anthony H. Sarno at St. John's University in Brooklyn, NY in 1167 (1951.). I happened to know Tony Sarno who was a master professor, but at the time he good-naturedly thought Gene was "nuts" by his choice of topic for a class project. Eventually, Tony became a convert and was indeed a member of the DSA for many years. This project produced Gene's first publication entitled "I'm a Dozener" in our *Duodecimal Bulletin* in 1169 (1953.). Over the years, Gene has authored or co-authored dozens of articles, puzzles, problems and fillers for us and the society is far richer as a result. Gene eventually became a Professor of Mathematics at Nassau Community College (SUNY) where he incorporated number bases in many of his mathematics and computer science classes. Thanks to Gene's tireless work, Nassau Community College housed an extensive dozenal collection for nearly two decades. It is obvious that dozenals were a labor of love for Gene who shared his enthusiasm very freely.

In 1193 (1981.), I submitted my first article entitled "A Group Theoretic Application of The Number Twelve" which Gene reviewed. He was very supportive of my initial work. Gene reviewed additional articles I submitted that were eventually accepted, and a genuine friendship ensued. Gene invited me to join the DSA and in 1197 (1987.), I became a member, one of the best decisions I ever made. Gene treated everyone as family. This was apparent in 1199 (1989.) when I was the featured speaker at our Annual Meeting at NCC. I have participated at every meeting since in some capacity. Thanks to Gene, I was able to take on additional roles in the DSA structure including Vice President, President, Secretary, Treasurer and Board Chair.

Finally, Gene's devotion to both his family and his faith was readily apparent. An ordained brother (Brother Louis Francis), Gene is survived by his son George who is very successful in the financial industry in Atlanta, GA, and his lovely wife Patricia (nee McCormick) of 55 (65.) years who was an accomplished theology professor at St. John's University and currently resides in Boynton Beach, FL. Rest in Peace, my friend. You will always be one of the very best and your spirit will always be shining down on us for perpetuity.

the mailbag

Thursday, April 4, 2019.

» Dear Society Members:

I am sorry to contact you in this manner, but I apparently do not have proper email addresses for you all. I tried to contact Jay Schiffman, and the message bounced back.

Gene Zirkel, my husband, passed away peacefully on Tuesday of this week after a long illness. He was 87.

Gene loved Dozenals and served the Society in many capacities for a very long time.

Thank you all for your friendship and good thoughts.

Best regards,
Patricia (Zirkel), Member №. 251; ⁞⁞⁞⁞

» Dear Pat,

My sincere condolences on the loss of Gene. Everyone in our Society felt honored to know him as a cherished friend, dozenalist and wonderful human being. His memory will always live on in our organization. My thoughts are with you at this time.

Jay (Schiffman), Member №. 278; ⁞⁞⁞

»

Here's that "Haiku for Gene" that I wrote in the DozensOnline Forum shortly after he died:

Mathematical
genius embracing the world
like a Great Zirkel.

John Volan, Editor ⁞⁞⁞

» Dear Mike:

I want to thank you for doing this. One thing I would say to the readers is that Gene truly believed in dozenal counting and measuring. To him, this was not a fad or a clever idea. The Society and its work was important to him, and he would be thrilled to know that you are memorializing him in this way.

Best regards,
Patricia (Zirkel), Member №. 251; ⁞⁞⁞⁞

Reflecting on Gene's life brings to mind a masterful song on the radio long ago:

New World in the Morning
Roger Whittaker, *The Last Farewell* (1183)

"I met a man who had a dream he'd had since he was twenty,
I met that man when he was sixzy*-one.*
He said, 'Too many folks just stand and wait until the morning.
Don't they know tomorrow never comes?'

And he would feel a new tomorrow coming on.
And when he'd smile his eyes would twinkle up in thought.
Now, everybody talks about a new world in the morning,
New world in the morning takes so long."

EDUCATION NEEDED

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Gene Zirkel · Nassau Community College · Garden City, li, ny

Gene Burns hosts a daily three-hour talk show on wor radio in nyc. On Monday 14 September his topic *Should we change to the metric system?* caught my attention. Driving home, I tuned in and listened to the pros and cons. I hurried home and dialed his number only to find that the line was busy. Thanks to my redial button, I patiently sat and listend while I pushed redial continuously. After thirty minutes I was connected and informed that I would be the first caller following the news. An additional 55 minutes transpired along with two news breaks as we came close to the conclusion of the show. At the last minute I was put on — the last caller of the day.

I was able to comment on a number of the silly things that I had heard, such as the metric system was "more precise" than our current English system.

I was able to explain that it was not "tens" that made the system seem easier but the use of the base. I spoke briefly about computers with base two or sixteen (the binary and hexadecimal bases respectively), and that the symbol "one zero" could represent any number.

I only had a short time, but I was able to mention factorability, and the dsa along with our address, and an offer to listeners to write for our literature.

I brought an historic view to the discussion by mentioning Lagrange and his committee who considered whether to change our measurements to tens or our counting to dozens. I used my favorite analogy — that it was like the problem of — your foot is too large for your shoe. You can either cut off your toes or get a larger shoe. Lagrange opted for changing the natural measurements with their halves, thirds, and quarters instead of the artificial counting based upon the biological accident of having ten figures.

Further, I noted that all of the countries that have gone metric, not one ever did so voluntarily. In every instance, laws were passed outlawed the sale of butter by the pound, rugs by the yard, etc. It would appear that if the metric system is as convenient as its advocates maintain, then somewhere, just once, ordinary people would have seen the truth and would have been willingly converted.

As our host noted, to replace all the highway signs with metric signs would cost "hundreds of millions of dollars." To the many people who repeated our need to switch to metric because of world trade and economic reasons, he replied - Fine, let manufacturers switch. "But I don't need to drive in kilometers per hour [in order for you] to manufacture in metric."

One caller, identified as Fred from Plainview, stated that 10 or 15 years ago the Encyclopedia Britannica had a six page essay on the advantages of keeping our current system, but it was pulled from later editions. If anyone can verify this, it would be extremely interesting. Gene Burns pointed out that it was about then that there was a big push for the usa to go metric.

Fred also said that most of the world lives in the temperate zones, and as a consequence our Fahrenheit temperature usually ranges from about 0° (cold) to about 100° (hot). On the other hand, those who use the awkward Celsius scale usually range from about 18° to about 38°! Interesting.

In conclusion, I believe that the more than one hour it took for me to be connected is indicative of the vast interest in this subject, both pro and con. In addition, I heard a great deal of misconceptions, a sign that our task of educating the public is as essential as ever.

GALLO ROMAN DODECAHEDRON : A NIGHT CANDLE CLOCK: PROPOSED USE OF THESE DEVICES

Raymond E. Greaves · Leighton Buzzard, Bedfordshire, England

Abstract

The Gallo Roman dodecahedra found mainly in northern Europe beginning with the first in 1739 have eluded accepted decision on their purpose and constitute an ongoing archaeological mystery. Different suggestions include a distance measure, military trajectory gauge, a glove knitting device, a crop seeding date gauge, a religious icon, a staff headpiece, a gambling die, and even a weapon. None of these have found agreement within the field of archeology.

This proposal is yet a new idea to which some may object given established tenets. We present evidence supporting our assertion, appreciating that the proposal may or may not be correct. We propose that the devices were used to hold wax candles of different dimensions for different times of year and for different latitudes to approximate night duration when sundials and water clocks would not serve, and in most cases were used to mark the passage of four watches as practiced by Roman military encampments.

The Dodecahedron

The dodecahedron artifact is a small hollow object made of copper or bronze alloy, cast into the shape of one of the five regular Platonic shapes. The twelve sided, pentagonal faced dodecahedron, each face with a circular but unique diameter hole and a ball finial on each vertex giving each face five finials where each finial is shared between three adjacent faces. Seen another way, these finials can serve as five feet for each face thus allowing every face to be made the bottom face and its opposite the top face where both top and bottom faces would lie horizontally and parallel with the ground or surface on which the object stands.

The twelve faces all have a central circular hole, each with a different diameter than all the other faces. Some faces have circular cast lines surrounding the holes with one or up to three such circles or more of different diameters and configurations, some with two outer circles and one smaller inner circle. The purpose of these is also yet unknown.

The devices themselves measure between 4 and 11 centimeters high, and the holes in any one example differ in size from any other dodecahedron. One broken part example (№. C996) in the London museum has three small balls at each vertex in place of one larger ball serving the same function as one larger ball.

Archaeological Finds

The very first dodecahedron was discovered in Aston, Hertfordshire, UK in 1739 by a local historian. Over 120 have been found throughout northern Europe, Hungary, Austria, Belgium, France, Germany, Luxembourg, the Netherlands, and Switzerland, but never near the Mediterranean. The finds have been in the area where Roman civilization overlaid Celtic civilization. Whether this implies that a cultural or metrological difference had some effect is not yet agreed. They range in size from 4 to 11 cm in height. No mention of dodecahedrons has been found in contemporary accounts. Some artifacts

turned up during controlled archeological digs, but most have been found by amateurs, in local shops and one included in grave goods. Thus the precise locations of most finds are unknown, but latitude could be inferred from their first appearance. This is significant in later descriptions of further investigations. Some of the artifacts are only fragments, others are complete but with some of the feet missing. The northernmost find was made at Hadrian's Wall in Northern Britain and the southernmost at Arles, France.

A Night Candle Clock

I knew about the artifacts for over two years, long pondering their purpose like myriads of more learned people, often academic. It seems to be the case now and then that revelation springs up in an individual without formal background. Possibly because an amateur is not as constrained by convention, they are free to see outside artificial boxes of knowledge held by the experts.

After the first meeting of the Leighton Linslade University of the Third Age, over two years after which the dodecahedrons were mentioned, I forgot the topic completely until that night just on the verge of falling asleep. I had a sudden burst of enlightenment that drew together the coincidence of twelve faces and twelve months of a year. With the idea that these devices could in fact be a means to approximately monitor night duration, along with the knowledge the length of night changes with the seasons, and that the Roman practice was to accept that hours change length depending on the date and location. The notion of hours during the night was not as important as the four watches [1] used by Romans during the night, thus it seemed that approximation was sufficient to monitor four watches.

How would this activity be performed? How would these dodecahedra be of use? How did different size holes add to its possible utility? Why were holes in one device different to the sizes in other examples in other locations? Bit by bit the ideas followed one by one, each adding another piece to the puzzle.

Artifacts with twelve different sized holes in each dodecahedron, one for each month of a year. More than one report mentions wax [2][3] on the object. Another report said the edges of the holes were beveled with rounded edges, suggesting they were made deliberately to minimize damage to anything pushed into them. That together with the wax, and some reports noting the devices show little evidence of wear, suggests anything put into the holes were themselves not overly hard to cause damage, yet also that the holes were designed to not damage the objects put into the holes.

All these clues taken together suggest candles, different size holes to accommodate candles of varying diameters. Varying candle sizes would burn for different durations.

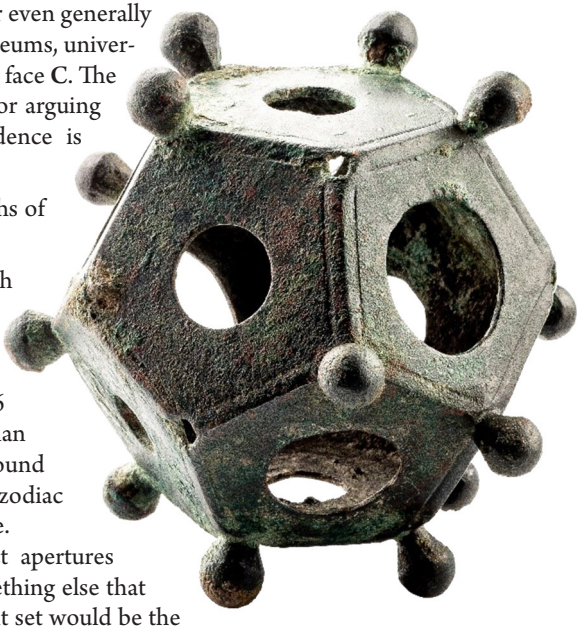
Placing candles of appropriate sizes into the hole in the correct face placed as the top surface, when stood on a level surface with the five feet of the opposite face at the bottom, would provide the needed function. This also revealed the purpose of the round feet at each vertex as a means to set each face at the top depending upon a suitable date each month. Candle diameter would determine the approximate burn rate depending on the appropriate month, and the size of holes determined for each device's latitude with candles made specifically for that device's predetermined sizes of holes.

This does not explain why each individual device had holes of different diameters from one device to another, but that was quickly explained by the fact that at different latitudes the duration of night would vary. This implied different size candles specific to each location and so each dodecahedron would need a unique set of hole sizes depend-

ing on latitude. The Romans were well able to determine latitude by means of Vitruvian equinoctial gnomons [4]. Given date and latitude, Romans could approximate the length of night. Given candles with known burn rate, people could choose the correct face and size of candle for any night, presumably the middle of each month to minimize the number of different diameter candles, twelve different sizes and enough of each size to last for a month with candles resupplied by a trustworthy chandler.

Examination of Evidence

Let's explore the evidence behind the assertion that the dodecahedra are candle holders. The current position of the following items describe what is known or proposed by others, published articles, or even generally accepted by archeologists, museums, universities and is identified by a bold face **C**. The rebuttal proposed by the author arguing with or without specific evidence is identified by a bold face **R**.



1.) 12 faces to match 12 months of the year.

C: Each device has 12 faces each with holes of varying size. The number of faces corresponds to the number of months in a year known to the Romans from 46 BCE and by us now as the Julian calendar. The dodecahedron found at Geneva in 1982 [5] has 12 zodiac signs displayed one to each face.
R: Twelve holes with distinct apertures imply correspondence to something else that is twelvefold. The most relevant set would be the number of months. The example found at Geneva [6] adds more weight to the suggestion of a direct one-to-one mapping of faces to months of the year.

2.) Wax has been found in some examples which suggests candles.

C: Examples have been found with wax residue. A number of sources suggest that this wax is most likely remnant from casting via the lost wax process. The penultimate form made of wax inside another negative mold is melted away when pouring the molten metal alloy, usually bronze into the mold. Most of the wax runs out of the form, leaving only small amounts, if any, in fine details.
R: The author at *Historic Mysteries* claimed, "However, many experts have dismissed this notion for two different reasons. First, the wax residue is probably a remnant of the lost wax process used in casting. Second, if these items were candlestick holders, why haven't archaeologists found a single example in Italy or regions of the Roman Empire around the Mediterranean?" [7] We might ask how does the possible use of the devices as candlestick holders relate with an absence of finds around the Roman Mediterranean. As a counterargument, why have water clocks not been found in Roman Europe, if as I suspect without access to records of such finds, none have been found? I suggest this

spurious conclusion about dodecahedra is unlikely. There is no interior relief for wax to coagulate during the lost wax process. Artisans creating expensive brass instruments might take better care than to let residual wax persist before sale. Owners of the extravagant instruments might be more careful to keep them presentable to impress guests. The lack of dodecahedra in some places may only mean they haven't been found yet. We posit that wax that remains in some artifacts derives from that falling from their use as candle holders, despite skepticism from some experts [8].

3.) Use of candle clocks.

C: The Greeks used candle clocks but there is no evidence of Roman use [9].
R: We do not know whether the Romans also used candle clocks, but it seems logical given the imperial relationship between Rome and Greece that Romans also used candle clocks, despite dismissal by some experts [10].

4.) Distinct hole sizes that might fit different diameter candles may correspond to the changing length of night each month throughout the year.

C: Each artifact has holes in each face of different sizes that also differ between artifacts. This makes their purpose unclear. Some argue that the holes could not relate as a means of measure due lack of standardization.
R: Location seems to be a plausible explanation for difference of hole diameters between artifacts. The duration of night varies between latitudes and dates. Therefore it seems logical that latitude could explain differences between pieces.

5.) Varying artifact sizes could relate to the different hole diameters so as to match the specific durations of night, depending upon date.

C: Accepting latitude dependent diameters that vary between artifacts, the second factor in hole diameter might be time of year.
R: Since it is expected this device was to be used continually throughout a year as suggested by the matching of faces to months, the size of candles and therefore the size of the holes governed burn length.

6.) Candle Burn Rate and Calibration.

C: Candle burn rate would need calibration taking account of artifact size, candle height and thickness, and wax quality.
R: Beeswax was likely used for consistency. More expensive than animal fat, affluent families or organizations like the military, baths, theaters, and villa estates would seem to be the likely user. Since the dodecahedra were relatively small, candle thickness would be better suited to adjust burn rate rather than taller candles that would prove less stable and more impractical

7.) The five ball feet at each vertex provides a stable stand, allowing every surface to be uppermost and horizontal.

C: Each of the round balls at every vertex of the device is shared by three different faces and each face has five feet.
R: The most likely purpose of the finials is as feet to make a stable stand. A round shape is practical and easy to furnish a workable stand for 3 adjacent faces no matter how the artifact is positioned. Others have suggested the balls were knobs for knitting finger covers, and that hole diameter served as forms for various finger diameters. Knitting is

believed to have come about a few centuries after the manufacture of the artifacts. The size of finger covers would be determined not by holes but the knobs, but these knobs have the same spacing since the dodecahedron is built of 12 identical pentagonal faces. One would additionally wonder why an expensive brass instrument was used instead of cheaper flat wood. Still others suggest improved grip afforded by round knobs, but other shapes would support better grip.

8.) The degree of workmanship to make such devices lends weight to the probable wealth or position of owners of such devices.

C: A dodecahedron was found in a coin hoard (Membrey, Saint Parize-le-Châtel [11]) in a woman's grave near a *villa rustica* (Greiner says that 4 dodecahedrons were possibly found in a *villa rustica*) prove that the dodecahedron was a possession of the wealthy.
R: The complexity of the artifact suggests a limited number of devices owned by affluent families or communal locations such as military posts, baths and theaters, places where most of these devices have been unearthed. In military forts or encampments, the four watches, approximate in length, were essential for sentry changes. Wealthy landowners wanted servants to make ready for next day by lighting fires for hypocausts and possibly similar needs for communal baths and theaters. Thus the majority of locations suggest these devices were used by communal places or wealthy landowners.

9.) The location of each find may suggest domestic or community uses — therefore static locations not for peripatetic use.

C: The majority of these articles with a known origin have been communal, such as crowds in public baths, theatres and Roman military camps or forts.
R: Artifact find suggests the dodecahedrons were permanent fixtures, not itinerant instruments. This supports hole sizing customized to a given locality and not moved from place to place.

7.) Some of these finds have circular grooves or lines with no apparent explanation.

C: Most objects have concentric circular grooves cast into them around holes, where betwen the holes the number and spacing of up to four grooves. The grooves may clue the user into which face is appropriate for given use.
R: It may be that these grooves signify which face was appropriate for the time of use, but this requires investigation as the artifacts require special access. The dodecahedron found in a funerary context in 1888/1889 in Bassenge may be of particular interest as its circles could associate each face with some specific month of a year. [12]

8.) Some holes feature beveled and rounded edges.

C: One dodecahedron is said to have holes with beveled rounded edges and several are said not to feature signs of wear. [13]
R: The devices were cast with eased hole edges designed specifically not to damage anything inserted in the holes. Along with evidence of wax in some artifacts and the careful design described above, a candle would seem to be the most relevant object placed into the holes.

10.) Location of finds in Northern Europe and not near the Mediterranean suggest they are of Roman/Gallic origin.

C: Most of the pieces have been found in present-day France, Germany and Great Britain: Gaul, Germania, and Britannia. As such, a common theory is that the Roman dodecahedron is of Celtic origin. None of these objects have appeared in Italy, North Africa or the Iberian Peninsula, some of Ancient Rome's key territories.
R: I find the idea these objects were of Celtic origin due to the location of finds in Gaul, France and the United Kingdom directly opposed to Roman origin, since all the finds have been dated to the period of Roman occupation from the 1st to the 4th centuries and none dated after the Roman departure. If Celtic, they would surely have still been in use after Roman culture departed.

11.) Why are dodecahedra only found in areas of Roman occupation?

C: Many reports of Roman dodecahedra make a point of posing a question of why these items are only found in Roman occupation areas remote from the Mediterranean. While the Greeks did not invent alarm clocks, they did invent a similar concept around the 4th century BCE. Their early alarm clock was called *κλεψύδρα*, clepsydra, a water clock. Romans used water clocks in the Mediterranean area. Why did the Romans in northerly climes apparently refrain from water clocks?
R: A water clock requires at least 2 vessels large enough to contain sufficient water to last the night. Due to varying durations of night depending on both latitude and month, water would need to be carefully measured to match the expected length of night. Furthermore, water may need replenishing during a night in order to mark the passing of the four night watches, suggesting these timepieces were cumbersome. A more portable small object no larger than 11 cm would be preferable.
The propensity of winter freezes would seem to nix the application of water clocks from northerly climes. Since water clocks were practical and common near the Mediterranean, they did not require another kind of device.

We might further speculate as to the calendar in use [14] (perhaps the Gaulish [15] with months of 29 or 30 days each?), the actual age of the artifacts (no later than the range of Roman occupation), and the use of artifacts to support agrarian planting (but then, why the finds in communal places or in treasure?) The usage of the devices to produce ballista would seem to result in ineffective ordnance. As a game device of chance, the varying weights of the faces would result in unfair rolls; the finials would hinder rolling. Similar problems face the prospect of the device as a tool of divination. As the head of a staff, the dodecahedron would not require holes in every face.

Roman Measure

Presently all measurement of the dodecahedra are in millimeters. It may be beneficial to convert these to Roman measures used at the time of manufacture. Comparison of hole diameters in each face may reveal a pattern intended by the makers not evident in millimeters. For example, one only needs to see the sizes of jars of jam or syrup in supermarkets in the UK with jars of 454 g (16 oz), 340 g (12 oz), 227 g (8 oz) and for syrup 907 g (2 lb). It is not known which basis of measure would have been used for the dodecahedra, but it would most likely have been either the 'digit' of ¾ of an inch or the Roman inch or *uncia pollex* which was itself one twelfth (1/12) of a Roman foot, and should specify the sizes including Roman fractions. The Roman foot or *pes* is given by Wikipedia as 0.971 of an Imperial foot to give a Roman inch of 24.6 mm (304.8 mm × 0.971/12 = 24.6 mm).

At the latest count, there have been over Roman 120 dodecahedra found. Since this is most likely to be only a small percentage of the numbers actually made during the Roman occupation of the northern areas during the first four centuries, there is bound to be many more that will never be found. This in turn suggests that if these devices were used as night clocks, there must have been a relatively large production of candles in order for their continued use.

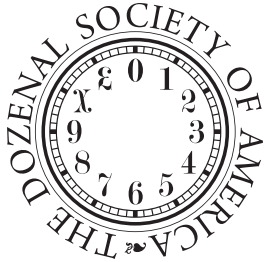
There have been no records found that give a clue as to their purpose, so it would be sensible to pursue alternate lines of investigation such as searching for records of chandlers' production that may shed some further evidence of candles for such night clocks.

[1] https://www.adavidsingh.com/time-ancient-rome/
[2] https://www.historicmysteries.com/roman-dodecahedron/
[3] https://www.littlegatepublishing.com/2022/03/roman-dodecahedron/
[4] https://sites.google.com/site/ancientdodecahedra/roman-dodecahedron
[5] https://bigthink.com/strange-maps/roman-dodecahedrons/
[6] https://www.grandcurtius.be/en/museums-collections/archaeology/dodecahedron
[7] https://www.historicmysteries.com/roman-dodecahedron/
[8] https://www.historydefined.net/what-was-the-purpose-of-a-roman-dodecahedron/
[9] https://earthlymission.com/candle-alarm-clocks-history-measure-time-wake-up/
[10] https://www.romandodecahedron.com/the-hypothesis
[11] https://www.grandcurtius.be/en/museums-collections/archaeology/dodecahedron
[12] https://en.wikipedia.org/wiki/Roman_dodecahedron
[13] https://english.elpais.com/culture/2022-12-19/weapons-mystical-devices-or-candle-holders-the-mystery-of-the-roman-dodecahedra.html
[14] https://en.wikipedia.org/wiki/Coligny_calendar#cite_ref-3
[15] https://tinkerings.org/2020/12/25/roman-dodecahedrons-part-iii/
[16] http://penelope.uchicago.edu/Thayer/E/Roman/Texts/Frontinus/De_Aquis/text*.html

Editor note: this is an abridgement of the original paper.

ROMAN FRACTIONS

Name	*As*	*Uncia*	*Name*	*As*	*Uncia*
As	1	10	Semuncia	1/20	1/2
Deunx	9/10	Ɛ	Duella	1/30	1/3
Dextans	7/10 = 5/6	Ƭ	Sicilicus	1/40	1/4
Dodrans	9/10 = 3/4	9	Sextula	1/60	1/6
Bes	8/10 = 2/3	8	Drachma	1/80	1/8
Septunx	7/10	7	Dimidio sextula	1/100	1/10
Semis	6/10 = 1/2	6	Tremissis	1/160	1/16
Quincunx	5/10	5	Scrupulus	1/200	1/20
Triens	4/10 = 1/3	4	Obulus	1/400	1/40
Quadrans	3/10 = 1/4	3	Bissiliqua	1/600	1/60
Sextans	2/10 = 1/6	2	Cerates	1/800	1/80
Sescuncia	1 1/10 = 1/8	1 1/2	Siliqua	1/1000	1/100
Uncia	1/10	1	Calcus	1/1400	1/140



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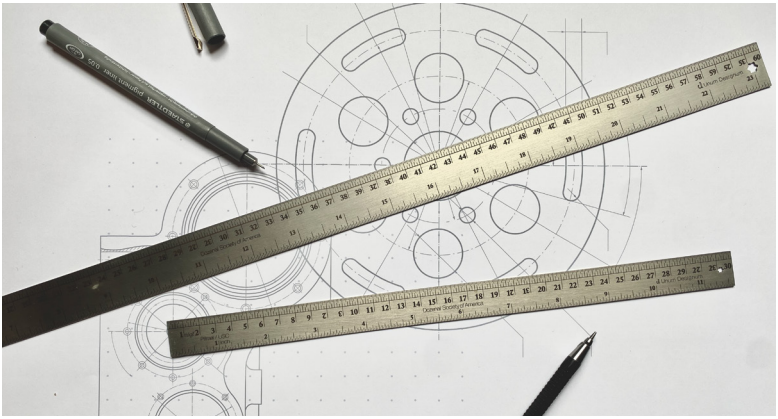

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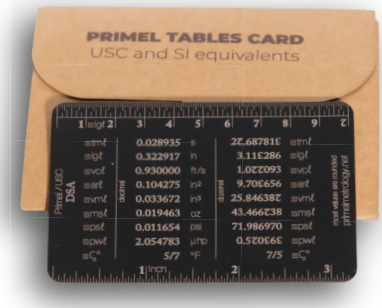

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