PI MU EPSILON JOURNAL

THE OFFICIAL PUBLICATION OF

THE HONORARY MATHEMATICAL FRATERNITY

VOLUME 1 NUMBER 6

CONTENTS

APRIL 1952

PI MU EPSILON JOURNAL
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OF THE HONORARY MATHEMATICAL FRATERNITY

MANUSCRIPTS and EDITORIAL CORRESPONDENCE, including CHAPTER REPORTS, NEWS ITEMS, etc., should be addressed to the Editor, Ruth W. Stokes, 15 Smith College, Syracuse University, Syracuse 10, New York.

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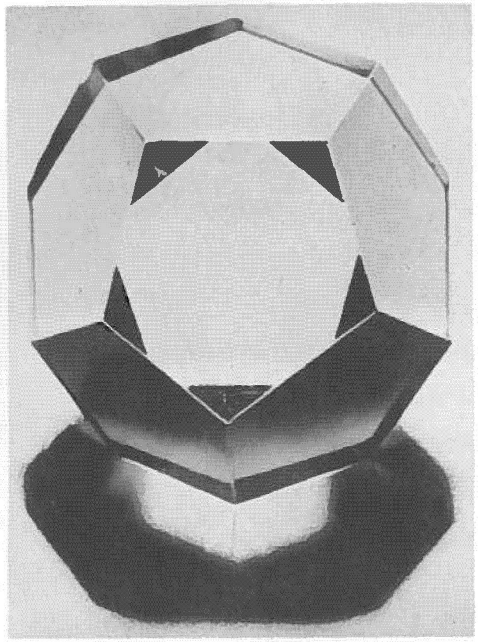
"It" is a dodecahedron — **one of the Euclidean** geometric "solids" **with twelve regular faces. (glass model)**



Since the time of Pythagoras, men have recognized that the techniques of many creative arts – architecture, sculpture, painting, music, and poetry – draw upon the principles which mathematicians have discovered. Less frequently, however – and least frequently in poetry – has a mathematical subject been transmuted into creative art.

Of poems treating mathematical subjects, probably the best known is **Millay's** sonnet on Euclid. The poem does not need the myth that has grown up about its creation: that, instead of studying for a geometry examination, **Millay** was so engrossed in achieving the artistic synthesis of her appreciation of Euclid that she failed the examination. Flawless in form, it is a poetic recognition of the pure beauty of mathematical form and mathematical reasoning, and of mathematics as the essence of systematic thinking.

-- Raven I. **McDavid, Jr.**

EUCLID ALONE HAS LOOKED ON BEAUTY BARE*
Edna St. Vincent **Millay**

Euclid alone has looked on Beauty Bare.
Let all who prate of Beauty hold their peace,
And lay them prone upon the earth and cease
To ponder on themselves, the while they stare
At nothing, intricately drawn nowhere
In shapes of shifting lineage; let geese
Gabble and hiss, but heroes seek release
From dusty bondage into luminous air.

O blinding hour, O holy, terrible day,
When first the shaft into his vision shone
Of light anatomized! Euclid alone
Has looked on Beauty bare. Fortunate they
Who, though once only and then but far away,
Have heard her massive sandal set on stone.

*"**Euclid** Alone Has Looked on Beauty Bare"
from the HARPWEAVER AND OTHER POEMS
published by Harper & Brothers

ARCHIMEDES AND THE THEORY OF NUMBERS[1]

E. T. Bell, California Institute of Technology

Tradition credits Archimedes with only one contribution to the theory of numbers. This is the famous Cattle Problem, which probably will never be fully disposed of in the sense of producing the complete numerical answer.[2] The circumstances under which the problem came to light in modern times are of interest. The German critic and dramatist, G. E. Lessing (1729-1781), spent most of the last decade of his laborious life dusting and sifting the treasures of the Wolfenbutel library (North Germany), where Leibniz had slaved out his last unrewarded years. Lessing was chief librarian. He made many discoveries of at least scholarly interest for their time and published them in a series of learned volumes. The first (1773) contained the Cattle Problem, a Greek 'epigram' in 44 lines of verse, headed "A problem which Archimedes found among (some) epigrams and sent, in his letter to Eratosthenes of Cyrene, to be solved by those in Alexandria who occupy themselves with such matters." The problem may have been suggested by a passage in the twelfth book of Homer's Odyssey: "Next, you will reach the island of Thrinacia (or Thrinakia, Sicily) where in great numbers graze kine and the sturdy flocks of the Sun."

The complete problem is in two parts. The first is easy today, the second is not, even today. Somewhat shortened the statement is as follows.

[1] Excerpt from "The Last problem."

[2] My account is indebted to the article by R. C. Archibald, American Mathematical Monthly, vol. 25, 1918, pp. 411–414, which contains numerous references to the extensive literature on the problem,

"Compute, O Friend, the host of the oxen of the Sun, giving thy mind thereto; if thou hast a share of wisdom, compute the number which once grazed upon the Sicilian isle Thrinacia, and which were divided according to color into four herds, one milk white, one black, one yellow, and one dappled. The number of bulls formed the majority of the animals and the relations between them were as follows."— As we would continue today, let W, w be the respective numbers of white bulls and white cows, and (X,x), (Y,y), (Z,z) the numbers of bulls and cows in the black, yellow, and dappled herds respectively. The first part of the problem is to solve (in positive integers) the following seven equations between the eight unknowns:

$$W = \left(\frac{1}{2} + \frac{1}{3}\right) X + Y,$$

$$X = \left(\frac{1}{4} + \frac{1}{5}\right) Z + Y,$$

$$Z = \left(\frac{1}{6} + \frac{1}{7}\right) W + Y,$$

$$w = \left(\frac{1}{3} + \frac{1}{4}\right) (X + x),$$

$$x = \left(\frac{1}{4} + \frac{1}{5}\right) (Z + z),$$

$$z = \left(\frac{1}{6} + \frac{1}{8}\right) (Y + y),$$

$$y = \left(\frac{1}{6} + \frac{1}{7}\right) (W + w).$$

Notice that the fractions are expressed in 'unit fractions' as an Egyptian of the time of Ahmes might have done, thus 1/2 + 1/3 instead of 5/6. These equations are (today) an easy indeterminate system – there are only seven equations for the eight unknowns. The solutions, where n is any positive integer, are

$$W = 10366482n, \qquad w = 7206360n,$$
$$X = 7460514n, \qquad x = 4893246n,$$
$$Y = 4149387n, \qquad y = 5439213n,$$
$$Z = 7358060n, \qquad z = 3515820n.$$

Even for $n = 1$, giving the smallest numbers satisfying the equations, the herd must have stood several deep on the island of Sicily. But this is only a paltry beginning. In passing, the calculations for this much of the problem, simple to us, might have taxed a skilled computer having at his command only the Greek alphabetical system of writing numbers or even the Babylonian sexagesimal. Archimedes may have suspected as much, for he says, "If thou canst give, O Friend,, the number of bulls and cows in each herd thou art not unknowing or unskilled in numbers, but still not yet to be counted among the wise." He then stiffens the problem very considerably by imposing two further conditions which the numbers of bulls must satisfy.

'Consider, however, the following additional relations between the numbers of bulls of the Sun:

$$W + X = \text{a square number},$$

$$Z + Y = \text{a triangular number}.$$

When thou hast computed the totals of the herds, O Friend, go forth as a conqueror, and rest assured that thou art proved most skilled in the science of number."

That was rather rubbing it in. With the values of W, X, Z, Y as above satisfying the first part, the problem now demands the solution of

$$W + X = u^2, \quad Z + Y = \frac{1}{2}v\,(v + 1),$$

where u, v are unknown numbers, and this in turn, as easily shown, requires numbers T, U to satisfy

$$T^2 - 4729494\,U^2 = 1.$$

The last equation is of the general type

$$T^2 - DU^2 = 1,$$

where D is a positive integer having no square divisor exceeding 1. By a historical mistake it is named after an eccentric character but mediocre mathematician, John **Pell (1610-1685),** and is called a Pellian equation. It is too late now to right the mistake; the equation should have been named after **Fermat.** The method for solving it completely is now well known, and is the important algorithm of continued fractions in the current theory of numbers. (The older English school algebras used to include the algorithm.) It is by no means obvious that an equation of this type for any given D of the prescribed form necessarily has a solution T, U, and indeed an infinity of solutions. The existence of a solution was proved only in 1776, when **Lagrange** (1736-1813) succeeded after many attempts which, he said, had cost him more thought than any of his other great successes and perhaps more than they may have been worth.

The least solution **T,U** for Archimedes' D = 4729494 was computed in 1880 by A. Amthor. It is

T = 109,931,986,732,829,734,979,866,232,821,433,543,901,
088,049,

U = 50,549,485,234,315,033,074,477,819,735,540,408,986,340.

I willingly leave to the reader the pleasure of verifying that these **T,U** actually satisfy the equation.

If — which seems most unlikely — Archimedes knew that his final equation must have a solution he was about twenty centuries ahead of his time. In fact he would have had to know as much as Lagrange unless, of course, he succeeded in calculating the required numbers **T,U** — an extremely laborious process — and proceeded thence in an attempt to compute the total number of cattle in the herd. If he succeeded in the last he surpassed any calculating machine yet invented or ever likely to be. For Amthor proved that W is a number of 206545 digits, and the total number in the herd also requires this many. To give some idea of the magnitude of these numbers, Amthor said, "It is easy to show that a sphere having the diameter of the Milky Way, across which light (speeding at 186000 miles a second) takes ten thousand years to travel, could contain only a part of this great number of animals even if the size of each is that of the smallest bacterium." Amthor gives another illustration. To print all eight numbers of the solution, with 2500 digits to the page, would require a volume of over 660 pages. After all this it seems improbable that Gauss solved the Cattle Problem completely, as one of his uncritical admirers asserted that he had. There must have been a misunderstanding somewhere.

A cynic has remarked that as long as there is an unsolved problem, some fool will try to solve it, especially if the problem is unsolvable. Perhaps A. H. Bell (no relation to the present writer) and his two collaborators, constituting the Hillsboro Mathematical Club of Hillsboro, Illinois, in the 1890's, did not fully qualify for the cynic's remark, but they came close. After nearly four years of unpaid hard labor the members of the Club computed 30 or 31 of the first digits and 12 of the last for each of the eight unknown bull and cow numbers and for the total number in the herd. The results disagree with the more modest computations by Amthor. Does anybody wish to check the Club's computations? Or Amthor's? The field is open and wider than the plains of Thrinacia.

There is the inevitable question, was it really Archimedes who proposed the problem? If it was not, who else had brains enough to imagine such a horror? The historical experts agree that Archimedes probably was responsible for the first part. Some, but not all, credit him also with inventing the second part. Again, if it was not Archimedes, what unknown genius constructed an elaborate <u>solvable</u> problem leading to indeterminate equations of the second degree? Equations of this kind written down at random are far more likely than not to have no solution. The final verdict according to some scholars is that it was Archimedes after all who successfully set the hard second part.

The evidence is not mathematical but human: "The unmistakable vein of satire in the opening words of the epigram, and in the transition from the first to the second part, and in the last lines, was a shaft directed toward Apollonius."

This is the only time that Apollonius, "the Great Geometer" as he was justly called by the Greeks, the Moslems, and their successors, figures as a contributor to the theory of numbers. A geometer who could inspire anything as hellish as the Cattle Problem must have been an arithmetician, even if only an involuntary one, of no small order. If Archimedes ever sent his close and respected friend, Eratosthenes, anything for himself nearly so provocative as the Thrinacian bulls and cows, it has not survived.

The occasion for Archimedes' 'shaft' was the problem of approximating to π, the ratio of the circumference of any circle to its diameter. To 7 places $\pi = 3.1415926$, which is considerably farther than any of the Greeks got. (An Eniac calculating machine in about 70 hours performed the superhuman feat of computing π to 2035 places.) Archimedes had shown that π is less than $3\frac{1}{7}$ and greater than $3\frac{10}{71}$. Apollonius claimed a closer approximation, and is said to have boasted about his superiority over Archimedes. He also exploited a system for writing and manipulating large numbers that he claimed was better than the similar venture of Archimedes in his "sand reckoner" —which need not be described as it has nothing to do with the theory of numbers; it was a scheme, ingenious for its time, of constructing large numbers. Archimedes drove Apollonius to cover by hurling the Cattle Problem at him from ambush. The huge numbers required to solve the problem were beyond human computation by any means Apollonius could possibly have known. They might even cause an electronic calculator to blow a battery of tubes.

PROBLEM DEPARTMENT

Edited by Leo Moser, University of Alberta

This department welcomes problems believed to be new and, as a rule, demanding no greater ability in problem solving than that of the average member of the Fraternity, but occasionally we shall publish problems that should challenge the ability of the advanced undergraduate and/or candictate for the Master's degree. Solutions of these problems should be submitted on separate, signed sheets within five months after publication. Address all communications concerning problems to Leo Moser, Mathematics Department, University of Alberta, Edmonton, Alberta, Canada.

PROBLEMS FOR SOLUTION

35. Proposed by N. S. Mendelsohn, University of Manitoba

A point moves in a straight line starting from rest and finishing at rest, and covers unit distance in unit time. Prove that at some point its acceleration has a magnitude of at least 4 units.

36. Proposed by Joan Sherley, Syracuse University

A man wishes to plant an orchard with n trees in ten straight rows, five in a row. What is the smallest value n can have?

37. Proposed by Victor Thébault, Tennie Sarthe, France

Find all pairs of three digit numbers M and N such that $M \cdot N = P$ and $M' \cdot N' = P'$, where $M' \cdot N'$ and P' are the numbers $M \cdot N$ and P written backwards. For example,

$$122 \times 213 = 25986$$

and

$$221 \times 312 = 68952$$

38. Proposed by C. W. Trigg, Los Angeles City College.

In the triangle ABC, AA' is a median. Prove that if

$$\frac{AM}{MA'} = \frac{p}{q}$$

then CM extended divides AB in the ratio

$$\frac{p}{2q}$$

39. Proposed by Pedro Piza, San Juan, Puerto Rico

Find digits m, a, b, c, d, e, f, such that

$$\frac{9m+1}{9m}\ \text{abcdef} = \text{fedcba}$$

40. Proposed by J. H. Butchart, Arizona State College.

Three infinitely long parallel wires carry electrostatic charges e_1, e_2, e_3 per unit length, where $2e_1 = 2e_2 = -e_3$. Show that if the cross section of the wires is an equilateral triangle then the circumscribed circle to this triangle is a line of force.

41. Proposed by Chester McMaster, New York City

There are more chess masters in New York City than in the rest of the U. S. combined. A chess tournament is planned, in which all American masters are expected to attend. In determining the site of the tournament it is agreed that the primary consideration should be the minimization of the total inter-city distance covered by all participants. The New York masters claim that by this criterion the site chosen should be their city. The west coast players and some others claim that a city at or near the center of gravity or centroid of the players would be better. Prove that the New Yorkers are right.

42. Proposed by Mel Stover, Winnipeg, Manitoba

Prove that the volume of a tetrahedron determined by two line segments lying on two skew lines is unaltered by sliding the segments along their lines (but leaving their lengths unaltered).

43. Proposed by Paul W. Gilbert, Syracuse University

Four solid spheres lie on top of a table. Each sphere is tangent to the other three. If three of the spheres have the same radius R, what is the radius of the fourth sphere?

44. Proposed by Paul W. Gilbert, Syracuse University

Assuming that c is a positive constant, solve the following equation for x:

$$2 \log_x c - \log_{cx} c - 3 \log_{c^2x} c = 0$$

Editorial Note. Professor Gilbert, as Faculty Adviser for the New York Alpha Chapter, used problems 43 and 44 as "Problems of the Month." He does not claim to have

originated them. They appeared elsewhere in mathematical literature, without proof, but we believe they will be of sufficient interest to our readers to warrant reprinting.

SOLUTIONS

5. Proposed by P. M. Anselone, College of Puget Sound

If $$F(M,N) = M!\,(N+1) \sum_{i=0}^{M} \frac{(M+N-i)!}{(M-i)!}$$

Show that $F(M,N) = F(N,M)$

Solution by William Moser, University of Toronto

We use induction over M to prove $F(M,N) = (M+N+1)!$ which clearly implies the required result. For $M = 1$, $F(1,N) = (N+2)!$ is easily checked directly. Assuming now that $F(M,N) = (M+N+1)!$ we have

$$F(M+1,N) = (M+1)!(N+1) \sum_{i=0}^{M+1} \frac{(M+1+N-i)}{(M+1-i)!}$$

$$= (M+1)M!(N+1)\left\{\frac{(M+N+1)!}{(M+1)!} + \sum_{i=0}^{M} \frac{(M+N-i)!}{(M-i)!}\right\}$$

$$= (M+1)M!(N+1)\left\{\frac{(M+N+1)!}{(M+1)!} + (M+N+1)!\right\}$$

$$= (M+N+1)!(N+1+M+1) = (M+N+2)!$$

which completes the proof.

Also solved by C. W. Trigg.

6. Proposed by C. W. Trigg, Los Angeles City College

Starting with a straight edge, closed compasses, and two straight line segments a and b, construct the harmonic mean of a and b in the least number of operations. Changing the opening of the compasses, drawing a circle or the arc of a circle, and drawing a straight line are each considered an operation.

Partial Solution by the Proposer

In the following discussion the number in parentheses is the ordered number of the operation.

Construction: Open the compasses to a radius a (1), and with an arbitrary point A as center describe a circle (2). With B an arbitrary point on the circle as center, describe a circle cutting the first circle at C and D (3). Draw AB extended (4) and AD extended (5). Change the opening of the compasses to equal b (6). With A as center describe a circle cutting AD at E (7). Draw CE cutting AB at F (8). Change the opening of the compasses to equal AF (9). With F as center describe a circle cutting AB at A and G (10). AG = c is the harmonic mean of a and b.

Proof: Draw CA, and draw FH parallel to CA cutting AD at H. $\angle DAB = 60^\circ = \angle CAB = \angle AFH$, so triangle AFH is equilateral and FH = AH = AF = $c/2$. It follows that $(b - c/2) : c/2 :: b : a$, so $c = 2ab/(a + b)$.

Editorial Note: Though the above constructions seem quite efficient, it is not proved that ten is the least number of operations possible. A proof that this is indeed the case, or a construction involving fewer operations would be welcome.

30. Proposed by J. H. Butchart, Arizona State College

A well known construction for the roots of $x^2 - px + q = 0$ is to find the x intercepts of the circle having the join

of (0,1) and (p,q) as diameter. Show that if the roots are complex, the real part is the abscissa of the center and the coefficient of i is the tangent from (p/2, 0) to this circle.

Solution by Roy Sinclair, University of Alberta

The coordinates of the center of the circle are $(\frac{p}{2}, (q+1)/2)$. The square of its radius is $(\frac{p}{2})^2 + ((q+1)/2 - 1)^2 = (p^2 + (q-1)^2)/4$. The distance between $(p/2, 0)$ and the center is $(q+1)/2$. Hence if L is the tangent length then $L^2 = (q-1)^2/4 - (p^2 + (q-1)^2)/4 = (4q - p^2)/4$ or $L = (4q - p^2)^{\frac{1}{2}}/2$. Since the complex roots of $x^2 - px + q = 0$ are $p/2 \pm i(4q - p^2)^{\frac{1}{2}}/2$ the theorem is proved.

Also solved by C. W. Trigg.

33. Proposed by C. W. Trigg, Los Angeles City College

It is well known that the elements of the fourth row (or column) of the Pascal triangle are tetrahedral numbers. Establish the following properties of the fourth row.

1. The difference of two consecutive elements is a triangular number.
2. The difference of two alternate elements is a square.
3. The difference of the $(n + 2)$nd and the nth elements increased by the $(n + 1)$st element of the third row is a pentagonal number.
4. Six times the nth element added to the $(n + 1)$st element of the second row is a cube.
5. The nth element is equal to the sum of the first n elements of the third row.

Solution by the proposer

The nth element of the rth row of the Pascal triangle is $C(n+r-2, r-1)$.

1. $C(n+3,3) - C(n+2,3) = (n+2)(n+1)/2 = C(n+2,2)$, the $(n+1)$st element of the third row.

2. $C(n+4,3) - C(n+2,3) = (n+4)(n+3)(n+2) = (n+2)(n+1)n/6 = (n+2)^2$, the square of the $(n+2)$nd element of the second row.

3. $C(n+4,3) - C(n+2,3) + C(n+2,2) = (n+2)^2 + (n+2)(n+1)/2 = (n+2)(3n+5)/2$.

4. $6C(n+2,3) + C(n+1,1) = (n+2)(n+1)n + (n+1) = (n+1)^3$.

5. $C(n+r-2,r-1) = C(n+r-3,r-2) + C(n+r-3,r-1)$
$= C(n+r-3,r-2) + C(n+r-4,r-2) + C(n+r-4,r-1)$
$= \cdots = C(n+r-3,r-2) + C(n+r-4,r-2) + \cdots + C(r-1,r-1)$.

Now $C(r-1,r-1) = C(r-2,r-2)$, so the nth element of the rth row is equal to the sum of the first n elements of the $(r-1)$st row. That is, this property is not restricted to the fourth row alone.

34. Proposed by J. S. Frame, Michigan State College

For what values of k are the following twelve points the vertices of a regular icosahedron? $(0, \pm k, \pm 1)$, $(\pm 1, 0, \pm k)$, $(\pm k, \pm 1, 0)$?

Solution by the proposer

If k satisfies the condition, so do -k, $1/k$, and $-1/k$. We therefore look first for all solutions between 0 and 1 and find the rest from these. Five vertices are adjacent to and equally distant from the vertex $(0,k,1)$, and the five vertices opposite these are adjacent to $(0,-k,-1)$. From $(0,k,1)$ to $(0,-k,1)$ the squared distance is $4k^2$, whereas from $(0,k,1)$ to each of the other adjacent vertices the squared distance is $1 + k^2 + (1-k)^2$. Hence

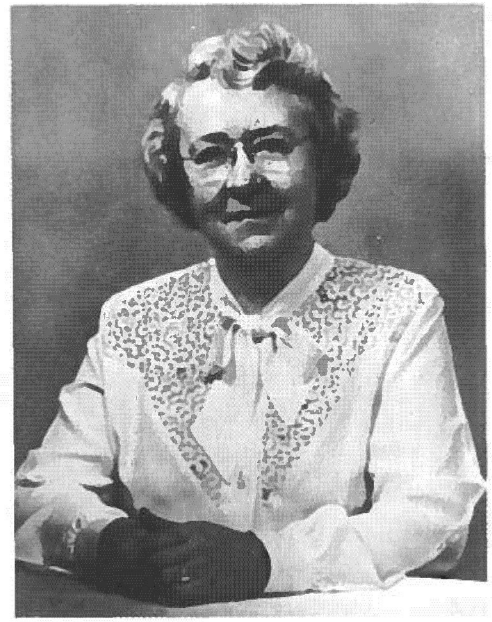
$$4k^2 = 1 + k^2 + (1-k)^2, \text{ or } (2k+1)^2 = 5$$

From the one solution between 0 and 1 we obtain the four solutions:

$$k = \frac{\pm 1 \pm \sqrt{5}}{2}$$

It is clear that for these values of k the given points have the required property.

PI MU EPSILON JOURNAL STAFF



RUTH WYCKLIFFE STOKES

EDITOR-IN-CHIEF

RUTH WYCKLIFFE STOKES, Assistant Professor of Mathematics, Syracuse University. Native of Greenville, S. C. A.B, Winthrop Col; M.A, Vanderbilt; Ph.D. (math), Duke. Teacher, high sch, S.C; asst. prof. math, Winthrop Col; instr, Duke; asso. prof, N. Texas State Col; prof. and dept. head, Mitchell Col; prof. and dept. head (astron. and math), Winthrop Col, 36–46; visiting prof, Brown Univ, summer, 42; asst. prof. math, Syracuse, 46--. Math. Soc; Math. Asn. (v-chr, 41–46; chr, 46–47) So. E. Sec; Nat. Council Teachers Math. (director, 45-47); Astron. Soc. Pacific; fellow, AAAS; Sigma Delta Epsilon (Secy, 49–50); Sigma Xi; Pi Mu Epsilon; founder and ed. 'Pi Mu Epsilon Journal (49--). A geometric theory of solution of linear inequalities; symbolic quadratic forms; construction of models illustrating almost all branches of mathematics.

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NEAL HENRY McCOY

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NEAL HENRY McCOY, Professor of Mathematics and Department Chairman. Smith College. Native of Waukomis, Okla. A.B, Baylor; M.S, Ph.D, Iowa. Teacher, highsch, Texas; nat. research fellow, Princeton; asst. prof. math, assoc. prof, prof, Smith Col, 42--. Math. Soc; Math. Asn. (2nd v-pres, 49-50; assoc. ed. 'Math. Monthly'). Author of Carus Monograph, "Rings and Ideals." Editor of Duke Math. Journal, 1951--. Algebra and quantum mechanics; theory of matrices; modern algebra; theory of rings.

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LEO MOSER, Lecturer in Mathematics, University of Alberta. B.Sc, Manitoba; M.A, Toronto; Ph.D, University of North Carolina. Lecturer, University of Manitoba, 1947-49; asso. prof, Texas Technological College, 1950-51. Member American Mathematical Society; Mathematical Association of America; Canadian Mathematical Congress; Sigma Xi; Pi Mu Epsilon. Number theory; geometry; mathematical recreations.

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ROBERT JOHN WALKER, Professor of Mathematics and Department Head, Cornell University, Ithaca, N.Y. Native of Pittsburg, Pa. B.S, Carnegie Inst. Tech; fellow, Ph.D (math), instr, Princeton; asst. prof, assoc. prof, prof (48--), dept. head (50--), Cornell. Lecturer, Princeton, 40-41; mathematician, Aberdeen Proving Ground, Md, 43-45. Assoc. ed, 'Duke Math. Jour.' Math. Soc; Math. Asn. (assoc. ed, 'Math. Monthly'). Singularities of algebraic manifolds; magic squares; artillery rockets.

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HOWARD CURTIS BENNETT

GENERAL OFFICERS OF THE FRATERNITY
(Continued from Volume 1, Number 5)

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TOMLINSON FORT, Professor of Mathematics and Head of the Department, University of Georgia. Native of Albany, Georgia. **A.B, A.M,** U. of Georgia; **A.M, Ph.D,** Harvard; also, **Kirkland** traveling fellow from Harvard, Europe. Instructor in mathematics, Georgia, Harvard, Michigan; **Asst.** Prof, Michigan; Professor, Alabama, Hunter College; Professor and Dean, Graduate School, Lehigh; Prof. Mathematics, Georgia, 1945--. **A.A;** Math. **Soc. (Asso. sec'y);** Math. **Asn.** (v. pres.), Director General of Pi Mu Epsilon Fraternity; Editor, Bulletin of American Mathematical Society. Author: Infinite Series 1930; Analytic Geometry (with others) 1932; Difference Equations 1948; Calculus 1951. Research: Infinite series; finite difference; linear difference equations.

COUNCILOR GENERAL

RUTH WYCKLIFFE STOKES (See 'PI MU EPSILON JOURNAL STAFF' for photograph and biographical sketch.)

EX OFFICIO MEMBER OF THE COUNCIL

HOWARD CURTIS BENNETT **(See 'PI** MU EPSILON JOURNAL STAFF' for photograph and biographical sketch.)

REPORTS OF THE CHAPTERS

(Send reports to Ruth W. Stokes, 15 Smith College, Syracuse University, Syracuse 10, New York.)

EDITOR'S NOTE. According to Article VI, Section 3 of the Constitution: "The Secretary shall keep account of all meetings and transactions of the chapter and, before the close of the academic year, shall send to the Secretary-General and to the **Director-**General, an annual report of the chapter activities including programs of meetings, results of elections, etc." The **Secretary-**General now suggests that an additional copy of the annual report of each chapter be sent to the editor of the Pi Mu Epsilon Journal. Besides the information listed above we are especially interested in learning what the chapters are doing by way of competitive examinations, medals, prizes and scholarships. These annual reports will be published in the chronological order in which they are received.

Alpha of Iowa, Iowa State College

During the school year 1950-1951, the following papers were presented at meetings of Iowa Alpha chapter:

"Paradoxes simple and complex" by Dr. Joe Foote

"The use of matrix notation for transfer functions of physical systems" by Mr. A. J. Bradt

"Some equations for absorption of gases" by Dr. Robert **S.** Hansen.

We held eight meetings during the year, including two initiation banquets held immediately after fall and spring initiation in honor of the initiates. We initiated 58 persons this year.

Officers for 1950-1951 were: Director, Eleanor Johns; **Vice-**Director, Richard E. Johnson; Secretary, Ella Mae Whatley; Treasurer, Leslie Gates; Faculty Adviser, Ralph M. Robinson.

Officers elected for 1951-1952 are: Director, Richard E. Johnson; Vice-Director, John Druyor; Secretary, Caroline Iverson; Treasurer, Donald Klippenstein; Faculty Adviser, Ralph M. Robinson.

Alpha of Alabama, University of Alabama

The Alabama Alpha chapter of Pi Mu Epsilon held four program meetings during the academic year 1950-1951, in addition to two combined business meetings and initiation ceremonies. Two social functions, a Christmas party and a spring picnic, were held.

The following papers were presented:

"Methods of reducing curves to unit curves in integration" by Herbert Diekhans

"Statistics, common sense and epistemology" by Professor O. L. Lacey

"The origin of mathematics" by Hassel Palmer

"Theorem of Helly" by B. Vanderburg.

The chapter initiated into membership twenty-four students and faculty members.

The following officers were elected for the academic year 1951-1952: Director, Donald A. Swenson; Vice-Director, Ying Victor Wu; Secretary, Betty Campbell; Treasurer, Louis Jaffe; Librarian, Dr. J. D. Mancill; Social Chairman, Elizabeth Cathey.

Delta of New York, New York University

At the beginning of the academic year 1950-1951, Elaine Weiss was Director; Alvin Saperstein, Vice-Director; Mordecai Schwartz, Secretary; and Dr. Gottfried E. Noether, Permanent Secretary-Treasurer. Due to the mid year graduation of Director Weiss and Secretary Schwartz, Vice-Director Saperstein was asked to assume the duties of both director and secretary for the second semester.

The chapter held five meetings during the year and the following papers were presented:

"The principle of the computing machine" by Dr. Gerald Goertzel

"Mathematics between the Scylla of physics and the Charybdis of logic" by Dr. John Van Heijenoort

"Probability theory and games of chance" by Dr. Gottfried E. Noether

"The drunkard's path or the gambler's ruin" by Dr. Bernard Friedman

"The foundations of physics" by Dr. Henry Margenau.

Officers elected for 1951-1952 are: Director, Willard L. Maranker; Vice-Director, Walter Koppelman; Secretary, William C. Zoellner.

Alpha of Michigan, Michigan State College

The chapter held thirteen meetings during the year 1950-1951, including business meetings, program meetings, initiations, the annual winter banquet and the spring picnic. Topics at program meetings were as follows:

"Dissection problems on squares" by Dr. Stewart

"Applications of mechanics to geometry" by Dr. L. M. Kelly

"Soap film problem" by James Powell

"Mathematics as a career," a panel discussion led by Doctors Stewart, Powell, Wells, Katz and Herzog

"The problem of the queens" by Dr. Herzog

"Education in Puerto Rico" by Dr. Grove

"The modern theory of dimensions" by Dr. Nordhaus.

At the winter banquet, Professor George Piranian, of the University of Michigan, was the guest speaker. The subject of his talk was "Series and Sequences."

Officers for the year 1951-1952 are: President, Paul Buben; Vice-President, Douglas Behr; Secretary, Henry Leonard; Treasurer, Charles Parker; Permanent Secretary, James Powell; Faculty Advisers, Dr. L. M. Kelly and Dr. J. E. Powell.

Gamma of Ohio, University of Toledo

The activities of the Ohio Gamma chapter for the year 1950-1951 included business and social meetings, the annual banquet and a "pot luck" supper. Topics for the talks given at the meetings were as follows:

"The mathematical method and problem solving" by Professor E. H. C. Hildebrandt

"One engineer's mathematics" by Clarence M. McDowell

"The Golden Section" by Dr. Wayne Dancer, banquet speaker

"The study of the cardioid by inversion" by Miss Violet Davis

"Mathematical engineering" by Ben Clymer (at the "pot luck" supper).

Officers for the year 1950-1951 were: Director, Miss Grace Cutler; Vice-Director, Martha Goodwin; Secretary, Anna Tom; Treasurer, Norman Krohn; Corresponding Secretary, Dr. Wayne Dancer.

Officers for the year 1951-1952 are: Director, Dr. C. E. Amos; Vice-Director, William McCord; Secretary, Jacqueline McLain; Treasurer, James F. Machen; Corresponding Secretary, Dr. Wayne Dancer.

Beta of California, University of California, Berkeley

During the year 1950-1951, the California Beta chapter held seven regular meetings exclusive of the fall initiation, banquet and spring initiation picnic. The pattern usually followed at meetings was this: a business meeting, the speaker for the evening, and adjournment for refreshments. Talks given were:

'Large scale high-speed computers" by Professor D. H. Lehmer

"The inner and outer development of mathematics" by Professor Abraham Seidenberg

"Algebraic identities involving sums of squares" by Professor Raphael M. Robinson

"Codification of geometry" by Dr. Ting-Kwan Pan

"Post algebra" by Mr. Ralph Willoughby

"Gambling and mathematics" by Professor Michel Loeve.

At the semi-annual initiation banquet twenty-four new members joined the chapter.

Swami Stoughton Bell baffled and delighted all present (at the April meeting) by his feats of magic and prestidigitation and his accompanying mathematical commentary.

The semi-annual initiation picnic was held at Live Oak Park in Berkeley. Twenty-seven new members joined the chapter.

In the spring semester, Stoughton Bell II was elected to the position of treasurer left vacant by Leonard Stimpson's leaving the University to accept a position. The officers for the year 1951-52 are: Director, William Noh; Vice-Director, Vivian Koblick; Secretary, Susan Chakmakjian; Treasurer, Newman H. Fisher, Jr.; Librarian, Sarah Hallum.

Beta of Washington, University of Washington

The first meeting for the 1950-1951 session was a business meeting at which the following officers were elected: Director, Richard Woollett; Vice-Director, Robert Wisner; Secretary-Treasurer, Miss Mary Ann Deggeller.

The following talks were presented during the academic year 1950-51:

"Cesaro, on one type of divergent integral" by Gerald Rogers

"Formal power series systems" by Dr. Richard W. Ball

"Waring's problem" by John Selfridge

"Tensor analysis" by Ted R. Jenkins

"Two-tuple rings" by Richard Byrne

"Rational decimic curves invariant under D-14" by James McKay

"Arithmetic of transfinite numbers" by Arthur Moskin

"Cantor's ternary set" by Douglas Newton

"Job opportunities for the mathematician" by Dr. Roy M. Winger.

The annual Spring Picnic for members, prospective members, faculty and friends; a "bridge-party"; and several short "coffee-sessions" made up the social program for the year.

There were seven new members elected and initiated into the Fraternity during the year. In addition, there are 37 "associates" elected and whose talks will be heard at future meetings, whereupon they will be elected to full membership.

Alpha of Virginia, University of Richmond

The Virginia Alpha chapter held nine meetings during the academic year 1950-1951, including business meetings, program meetings, fall initiation meeting and the annual banquet in May. Topics discussed at program meetings were the following:

"Mathematical side of astronomy" by Mr. Ogburn

"Topology" by Marion Jeffries

"Opportunities in the field of mathematics after graduation from college", a panel discussion led by Dr. C. H. Wheeler in, Samuel Smith and Barbara McGeehee

"A glimpse of time" by Miss Isabel Harris.

On the average, there were from twelve to twenty-five persons present at each meeting; and there were seven new members initiated during the year, bringing the total membership in the chapter since the charter was granted to 60.

Officers for 1950-1951 were: Director, Dr. C. H. Wheeler III; Vice-Director, Samuel L. Smith III; Secretary, Ann Jones; Treasurer, James D. Sutherland.

Officers for 1951-1952 are: Director, Dr. C. H. Wheeler III; Vice-Director, Willard E. Meador, Jr.; Secretary, James L. Judson; Treasurer, William F. Herget.

Alpha of Kentucky, University of Kentucky

During the academic year 1950-1951, the Kentucky Alpha chapter held six regular meetings in addition to the initiation banquet held in January. The following papers were presented:

"Report on the International Congress of Mathematicians" by Dr. V. F. Cowling

"An elementary geometry problem" by Dr. A. W. Goodman

"Calculating machines" by Dr. M. S. Davis

"On a problem of S. Bernstein" by Dr. V. F. Cowling

"A problem in linear algebras" by Mr. A. E. Foster

"Elasticity" by Dr. Tadeusz Leser.

At the initiation banquet Dr. K. O. Lang gave an entertaining talk on "Rain Making."

Officers for 1950-1951 were: Director, Wimberly C. Royster; Vice-Director, Donald C. Rose; Librarian, Cordell B. Moore, Secretary, A. E. Foster; Treasurer, Sherman B. Vanaman.

Officers for 1951-1952 are: Director, Donald C. Rose; Vice-Director, Ruric E. Wheeler; Librarian, Wilson M. Zaring; Secretary, William Swift; Treasurer, Ralph C. Brown.

The number of active members at the beginning of the year was 23 and the number of members initiated during the year was 16. The total membership in the chapter since the charter was granted is 256.

Alpha of the District of Columbia, Howard University

The installation ceremonies of this chapter were held on March 29, 1951, at Frazier Hall, Howard University. The installation ceremony was conducted by the Director General of the Fraternity, Professor C. C. MacDuffee.

Dr. Mordecai Wyatt Johnson, President of the University, accepted the Charter and Seal of the Fraternity for the University and Dr. Elbert F. Cox, for the Mathematics Department.

Dr. Walter T. Daniels of the School of Engineering and Architecture spoke on "Fundamental Research."

Initiation ceremonies were held following the installation banquet.

The chapter held three meetings following its installation. The first and second meetings were organizational.

At the May meeting Dr. Butcher of the Mathematics Department spoke on "What is a Tensor?"

Officers for the chapter are: Director, Dr. George H. Butcher; President, Lt. Robert N. Smith, USAF; Secretary, Mrs. Andretta Yeldell; Treasurer, Young Lee.

Alpha of Nebraska, University of Nebraska

Four program meetings were held by the Nebraska Alpha chapter during 1950-1951, in addition to the social meetings. The program consisted of the following talks:

"An application of the solution of a special recursive series" by Dr. H. B. Ribeiro

"A method of quality production control" by J. W. Adams

"Biology and mathematics" by Professor B. H. Burma

"Movement of pressure systems" by Professor L. K. Jackson.

The new officers for 1951-1952 are: Director, George Cobel; Vice-Director, Bruce Emmons; Secretary, Donna Grueber; Treasurer, Winfred Zacharias.

Beta of Pennsylvania, Bucknell University

The following papers were presented to the Pennsylvania Beta chapter during the year 1950-1951:

"The background of necessary and sufficient" by Emil Polak

"Diophantine problems" by Ralph Jones

"Dimensional analysis" by Francis Huber

"The cross ratio" by F. S. McFeely.

Officers elected for 1951-1952 are: Director, Professor W. K. Smith; Vice-Director, James E. Hole; Secretary, Rosemary Scheerer; Treasurer, C. Jerome Sechrist.

Alpha of Kansas, University of Kansas

The Kansas Alpha chapter held its annual spring banquet in April, 1951. The speaker, Professor E. S. Robinson, gave an address on "Why some philosophers are interested in mathematics."

The winter initiation and tea was held in January, and, in addition, there were several business meetings during the year.

The officers elected for the year 1951-1952 are: Director, Robert Fisher; Vice-Director, David Murcray; Secretary, James Larkin; Treasurer, Kathleen O'Donnell; Corresponding Secretary, Wealthy Babcock.

Beta of Illinois, Northwestern University

The program of the Northwestern University chapter for the year 1950-1951 was as follows:

"Theorems of the universe" by Dr. W. S. Krogdahl of the Department of Astronomy

"Interesting facts about numbers" by Dr. R. P. Boas

"Philosophy and mathematics" by Dr. Douglas Morgan of the Department of Philosophy

"Science and religion" by Dr. Edson Peck of the Department of Physics

"Analogue computer" by Dr. Elliott Buell, as part of a tour through the Technological Institute.

The officers elected for 1951-1952 are: President, Richard Goldberg; Vice-president, Franklin Peterson; Treasurer, David Whitehouse; Secretary, Grant Steffen.

ERRATA

The following errata in Volume 1, Number 5, have been called to the attention of the editors.

Page 180: In reference (1) the author's name is R. G. Archibald.

Page 191: In the second line from the bottom of the page, change "Sco" to "Soc".

"Professor," said the student in search of knowledge, "will you try to explain to me the theory of limits?"

"Well, young man, assume that you have called on a pretty young woman. You are seated at one end of the divan and she is seated at the other end. You move halfway toward her. Then you move half of the remaining distance toward her. And again you reduce the distance separating you from her by fifty per cent. Continue this for some time. Theoretically, you will never reach the girl. On the other hand, you will soon get close enough to her for practical purposes."

— DAVIDSON SCRIPTS 'N PRANKS

MEDALS, PRIZES AND SCHOLARSHIPS

EDITOR'S NOTE. Each chapter undoubtedly will be interested in learning what other chapters are doing along the line of prize competitions. So the editor makes the request that chapters offering prizes, scholarships, or other awards, write up their plans for such contests and submit them for publication in this journal.

In the Treasurer's Report of the New York Delta chapter there appeared this item: "Prizes for Mathematics Club, $35.00." The chapter should be congratulated on giving so generously to a most worthy cause.

The Michigan Alpha chapter annually makes the L. C. Plant awards. These are given to the students who have in the past year contributed the most to mathematics through scholarship, interest in mathematics and help to the mathematics department. Last year's awards were presented to Charles Parker and R. Douglas Behr by Dr. J. H. Bell.

The New York Alpha chapter this year introduced, as a part of its activities, a "Problem of the Month" feature. At each of the monthly meetings, the Faculty Adviser, Professor Paul Gilbert, proposes one or two problems to be solved by the members. The person who hands in the best solution of the problem (or problems) is awarded a Pi Mu Epsilon key, or cash award. In the Problem Section of this issue of the journal there appear the problems proposed for solution at the February meeting. The prize went to a senior in this year's graduating class, Leo A. Magnanti.

An open letter to the members and chapters of the Pi Mu Epsilon Fraternity:

A national meeting of the Pi Mu Epsilon Fraternity will be held at Michigan State College, East Lansing, Michigan, on Labor Day, September 1, 1952, just before the meetings of the Mathematical Association of America (September 1-2), and those of the American Mathematical Society (September 2-6). The Institute of Mathematical Statistics and the Econometric Society are also scheduling parallel meetings in East Lansing at that time. It is hoped that as many chapters as possible may send delegates.

The postcard ballot concerning this meeting was returned by a majority of the chapters, and all but three votes favored the meeting. Only two chapters were willing in January to promise to supply a student speaker, but others indicated that they might possibly supply one. They are urged to inform the Secretary General by May 15.

Although the program is not definite at this time, the following tentative outline is being considered.

Sunday, August 31,	**8:00** p.m.	Informal discussion meeting about programs for local chapter meetings, to serve as a basis for the round table discussion Monday morning.
	9:00 p.m.	Meeting of the National Council.
Monday, Sept. 1,	**9:00-11:00a.m.**	Four or five 20 minute talks, including at least two by students and at least one by a member of the National Council.
	11:15-11:45a.m.	Roundtable discussion on programs and activities of local chapters.

12:00	Lunch, followed by a 30 minute business meeting for members and delegates.
2:00 p.m.	Sessions of the Mathematical Association, including the first of three one hour Earle Raymond **Hedrick** Lectures by Professor Tibor Rado of Ohio State University on "Derivatives and Jacobians."
7:30 p.m.	If enough student speakers are available, an additional program Monday evening may be scheduled.

Each member of Pi Mu Epsilon who thinks he (or she) may possibly attend the meeting (and each chapter who may possibly send delegates) is urged to send a postcard addressed to the Secretary General (207 P. M., Michigan State College, East Lansing, Michigan) before June 1 giving his (or her) name, summer address, and chapter. These cards do not imply a definite commitment to attend, but serve as a mailing list. The Secretary will then mail final announcements of the program, (including the Mathematical Association program) and room reservation cards to those people and chapters before the end of June.

This is a real opportunity for students interested in mathematics to become acquainted with each other and with their future colleagues in the profession. The cooperation of each of you is requested to make this meeting a success.

February 28, 1952

J. Sutherland Frame
Secretary-Treasurer General

NEWS AND NOTICES

The Oklahoma Alpha Chapter of Pi Mu Epsilon is sponsoring a mathematical news letter addressed to high school students interested in mathematics. It seems to be a most worthy undertaking. Professor R. V. Andree, a contributor to and a loyal supporter of our own publication, the PI MU EPSILON JOURNAL, is acting as adviser to the OKLAHOMA UNIVERSITY MATHEMATICS LETTER. He has sent us a copy of Volume 1, Number 1, published December 1951, at Norman, Oklahoma. The following paragraph is an excerpt from Professor Andree's communication to the editor:

HIGH SCHOOL MATHEMATICS LETTER

> A mathematical letter will be mailed twice a semester to interested high school teachers by the University of Oklahoma Chapter of Pi Mu Epsilon. Each letter will contain mathematical news, a short article and a problem section. High school students are invited to submit solutions to the problems. A list of correct solvers will be carried in the next letter. High school teachers wishing to receive these letters should send their name and school address to Professor Richard Andree, Dept. of Mathematics, University of Oklahoma, Norman, Okla."

He states that each "Letter" will contain a short article. Believing that our readers will be interested in the short article on "oil recovery," which appeared in Number 1, and with permission of the O. U. Math. LETTER, we reprint the article here.

O. U. MATHEMATICAL RESEARCH IN OIL RECOVERY

> Many of you realize that when residual oil is recovered from underground .sand, water or gas is pumped into the sand to "flood out" the oil. Only about half of the oil is recovered in this manner; the rest remains around

> the points of contact of the grains of sand and in the narrower channels. One of the projects of the Research Institute of the University of Oklahoma is to study the geometry of the changing oil-water interface. It is known that under certain idealized conditions, the cross section of the oil-water interface is a curve traced by the focus of one branch of an hyperbola as the hyperbola rolls on a straight line. Two professors of the mathematics department are devoting time to a study of the idealized geometry of this problem through the use of differential equations. It is hoped this study will aid in a more complete understanding of the physics of residual oil recovery.

Copies of the Pi Mu Epsilon constitution and by-laws are available to the chapters as long as the present supply lasts at a charge of one dollar a dozen prepaid, or one dollar a dozen plus postage if payment is not made in advance.

A large supply of official key order blanks is available upon request.

A letter from Secretary-Treasurer Harry M. Gehman of the Mathematical Association of America called our attention to the availability of extra copies of the booklet entitled "Professional Opportunities in Mathematics," and he requested that we either print a review (for which he enclosed a copy) or at least give some space to the booklet in the Pi Mu Epsilon Journal. Though we are glad to meet the latter request, we are limited in responding to the former as we have not yet set up a "Review" section in the Journal.

We have, however, read the booklet carefully and recommend it strongly to our readers. Indeed, it is a timely article similar in intent to "Why Study Mathematics?," a condensation to a pamphlet published by the Canadian Mathematical Congress and prepared by Professor Norman Miller (Queen's College) and others, which we published in Number 3 of this journal. While the Canadian pamphlet was addressed to the interests of Canadian high school students, in the main, yet it was well received outside of Canada, not only by high school students but by those in college and university as well. The booklet published by the American Mathematical Monthly should be helpful to any young student who is considering mathematics as a career.

It was prepared by a committee of the Association, composed of W. H. Brinkman, Z. I. Mosesson, S. A. Schelkunoff, S. S. Wilks, and Mina Rees, Chairman. Reprints of this article (booklet) may be obtained from Professor H. M. **Gehman,** Mathematical Association of America, University of Buffalo, Buffalo 14, N. Y.; the cost is **25¢** for single copies and **10¢** each for orders of ten or more.

We are in receipt of a **communication** from Professor **Akit**sugu Kawaguchi, Faculty of Science, Hokkaido University, Sapporo, Japan, asking us to settle an exchange relation between the publication, TENSOR, of the Tensor Society and our publication, Pi Mu Epsilon Journal. TENSOR is now in **its** New Series, Volume 1, Number 1, having been published in 1950, only a few months after our Journal made its first appearance. It is the official organ of the Tensor Society for the publication of original researches of members of the Society.

Notice to Chapter Secretaries from the Business Manager

Will you please co-operate with me in the following three ways:

1. When the list of new initiates is sent to the Secretary General, send a copy of the names and addresses of initiates with the date of initiation to Pi Mu Epsilon Journal, 15 Smith College, Syracuse University, Syracuse 10, N. Y. This will enable us to distribute the Journal immediately after it is printed, thus avoiding a delay such as has been caused in some cases in the past, due to our lack of complete information.

2. Send, also, the name and address of the Permanent Secretary, or the Corresponding Secretary, or some other officer of your chapter, with whom we may communicate not only during the summer but also during the following academic year.

3. Advise each initiate that when he gives us a change of address he should state also the name of the chapter into which he was initiated.

Howard C. Bennett

DIRECTORY

of

PI MU EPSILON FRATERNITY, INC.

*

General Officers
(1951-1954)

Director General: Professor C. C. **MacDuffee,** 202 North Hall, University of Wisconsin, Madison 6, Wisconsin

Vice-Director General: Professor W. M. **Whyburn,** Department of Mathematics, University of North Carolina, Chapel Hill, North Carolina

Secretary-Treasurer General: Professor J. S. Frame, 207 Physics-Mathematics Bldg., Michigan State College, East Lansing, Michigan

Councilors General:

Professor S. S. Cairns, Department of Mathematics, University of Illinois, **Urbana,** Illinois

Professor Tomlinson Fort, Department of Mathematics, University of Georgia, Athens, Georgia

Professor Sophia McDonald, Department of Mathematics, University of California, Berkeley, California

Professor Ruth W. Stokes, Department of Mathematics, Syracuse University, Syracuse 10, New York

Mr. Howard C. Bennett (ex officio), Department of Mathematics, Syracuse University, Syracuse 10, New York

Corresponding Secretaries[1]
1951-1952[2]

(5) Alabama Alpha, 1922, University of Alabama, University, Ala.;
Dr. H. S. Thurston, Box 1453, University, Alabama

(40) Arizona Alpha, 1941, University of Arizona, Tucson, Arizona;
Dr. R. F. Graesser, Department of Mathematics

(22) Arkansas Alpha, 1931, University of Arkansas, Fayetteville, Arkansas;
Faculty Adviser: Professor S. L. Hull, Department of Mathematics

(12) California Alpha, 1925, University of California, Los Angeles 24, California;
Faculty Adviser: Prof. W. T. Puckett, Department of Mathematics

(19) California Beta, 1930, University of California, Berkeley 4, California;
Mrs. Sophia L. MacDonald, Room 453, Wheeler Hall

(33) Colorado Alpha, 1936, University of Colorado, Boulder, Colo.;
Professor Jack R. Britton, Department of Mathematics

(50) Colorado Beta, 1950, University of Denver, Denver, Colorado;
Miss Katherine C. Garland, Department of Mathematics

(41) Delaware Alpha, 1941, University of Delaware, Newark, Delaware;
Professor Russell Remage, Jr., Department of Mathematics

(52) District of Columbia Alpha, 1951, Howard University, Washington 1, D. C.;
Dr. G. H. Butcher, Jr., 2641 Myrtle Avenue, N. E.

(51) Florida Alpha, 1951, University of Miami, Coral Gables 46, Florida;
Mrs. Georgia Del Franco, Department of Mathematics

(29) Georgia Alpha, 1934, University of Georgia, Athens, Georgia;
Professor W. S. Beckwith, 731 Cobb Street

[1] When known, the name and address of the Permanent Secretary, or Corresponding Secretary, is given; otherwise, that of the Faculty Adviser or Department Chairman.

[2] Number appearing before chapter designation indicates chronological order in which charter was granted.

(7) Illinois Alpha, 1924, University of Illinois, Urbana, Illinois;
Prof. Echo Pepper, 1005 S. Sixth, Champaign, Illinois

(42) Illinois Beta, 1944, Northwestern University, Evanston, Ill.;
Mr. Richard R. Goldberg, Department of Mathematics

(6) Iowa Alpha, 1923, Iowa State College, Ames, Iowa;
Mr. Donald L. Klippenstein, Department of Mathematics

(16) Kansas Alpha, 1928, University of Kansas, Lawrence, Kansas;
Prof. Wealthy Babcock, 209 Strong Hall, Department of Mathematics

(31) Kansas State College, Manhattan, Kansas;
Prof. W. T. Stratton, Department of Mathematics

(49) Kansas Gamma, 1950, University of Wichita, Wichita, Kansas;
Professor C. B. Read, Department of Mathematics

(13) Kentucky Alpha, 1927, University of Kentucky, Lexington, Ky.;
Dr. H. H. Downing, Department of Mathematics

(38) Louisiana Alpha, 1939, Louisiana State University, Baton Rouge 3, Louisiana;
Professor H. T. Karnes, Department of Mathematics

(39) Michigan Alpha, 1940, Michigan State College, East Lansing, Michigan;
Dr. L. M. Kelly, Department of Mathematics

(4) Missouri Alpha, 1922, University of Missouri, Columbia, Missouri;
Professor Mary Cummings, 213 Engineering Building

(11) Missouri Beta, 1925, Washington University, St. Louis 5, Missouri;
Professor Jessica Young Stephens, Dept. of Mathematics

(43) Missouri Gamma, 1945, St. Louis University, St. Louis, Mo.;
Professor Francis Regan, Department of Mathematics

(9) Montana Alpha, 1925, Montana State University, Missoula, Montana;
Permanent Secretary: Prof. A. S. Merrill, 533 E. Beckwith

(15) Nebraska Alpha, 1928, University of Nebraska, Lincoln, Nebraska;
Faculty Adviser: Dr. Edwin Halfar, Dept. of Mathematics

(45) New Hampshire Alpha, 1948, University of New Hampshire, Durham, N. H.;
Miss Elinor Burleigh, Alpha Chi Omega

(1) New York Alpha, 1914, Syracuse University, Syracuse 10, New York;
Professor Nancy Cole, Department of Mathematics

(10) New York Beta, 1925, Hunter College, 695 Park Ave., New York 21, N. Y.;
Prof. Jewel Bushy and Miss Leila Singh, Department of Mathematics

(26) New York Gamma, 1933, Brooklyn College, Bedford Ave. and Ave. H., Brooklyn 10, N. Y.;
Prof. Moses Richardson, Department of Mathematics

(28) New York Delta, 1933, N. Y. University, 100 Washington Sq. East, New York 3, N. Y.;
Prof. Van Heijenoort, Department of Mathematics

(30) New York Epsilon, 1935, St. Lawrence University, Canton, New York;
Dr. Ruth Peters, Department of Mathematics

(53) New York Eta, 1951, University of Buffalo, Buffalo 14, N. Y.;
Mr. Howard W. Baeumler, Department of Mathematics

(24) North Carolina Alpha, 1932, Duke University, Durham, N.C.;
Prof. F. G. Dressel, 309 Frances Street, Durham, N. C.

(46) North Carolina Beta, 1948, Univ. of N. C., Chapel Hill, N. C.;
Dr. W. M. Whyburn, Department of Mathematics

(2) Ohio Alpha, 1919, Ohio State University, Columbus, Ohio;
Mr. Pat Sterbenz, Brand Road, Worthington, Ohio

(13) Ohio Beta, 1927, Ohio Wesleyan University, Delaware, Ohio;
Prof. Rufus Crane, 269 West William St., Delaware, Ohio

(32) Ohio Gamma, 1936, University of Toledo, Toledo, Ohio;
Dr. Wayne Dancer, Department of Mathematics

(48) Ohio Delta, 1949, Miami University, Oxford, Ohio;
Dr. H. S. Pollard, Upham Hall, Oxford, Ohio

(18) Oklahoma Alpha, University of Oklahoma, Norman, Oklahoma;
Professor Dora McFarland, Department of Mathematics

(35) Oklahoma Beta, Oklahoma A. and M. College, Stillwater, Oklahoma;
Professor James H. Zant, Department of Mathematics

(21) Oregon Alpha, 1931, University of Oregon, Eugene, Oregon;
Dr. K. S. Ghent, Department of Mathematics

(36) Oregon Beta, 1938, Oregon State College, Corvallis, Oregon;
Professor G. A. Williams, Department of Mathematics

(3) Pennsylvania Alpha, 1921, University of Pennsylvania, Philadelphia 4, Pennsylvania;
Dr. R. D. Shafer, Department of Mathematics

(8) Pennsylvania Beta, 1925, Bucknell University, Lewisburg, Pennsylvania;
Professor W. K. Smith, Department of Mathematics

(17) Pennsylvania Gamma, 1929, Lehigh University, Bethlehem, Pennsylvania;
Professor R. R. Stoll, Department of Mathematics

(20) Pennsylvania Delta, 1930, Pennsylvania State College, State College, Pennsylvania;
Mr. Walter J. Harrington, Department of Mathematics

(44) Pennsylvania Epsilon, 1947, Carnegie Inst. of Tech., Pittsburgh 12, Pennsylvania;
Professor David Moskovitz, Department of Mathematics

(47) Virginia Alpha, 1948, University of Richmond, Richmond, Va.;
Professor E. S. Grable, Box 45, University of Richmond

(25) Washington Beta, 1932, University of Washington, Seattle 5, Washington;
Dr. Roy Leipnik, Department of Mathematics

(27) Wisconsin Alpha, 1933, Marquette University, Milwaukee 3, Wisconsin;
Dr. H. P. Pettit, Department of Mathematics

(37) Wisconsin Beta, 1939, University of Wisconsin, Madison 6, Wisconsin;
Professor R. E. Fullerton, Dept. of Mathematics

INITIATES, ACADEMIC YEAR 1950–1951
(Continued from Vol. 1, No. 5)

COLORADO ALPHA, University of Colorado
(spring, 1951)

Jack Angevine
Ira Batt
Eugene Barrows
Carrol D. Beaman
Kenneth D. Brunelli
J. Richard Collins
Richard Cordingly
William L. Cox
Jean B. Cropley
Thomas G. Donaldson
Rueben H. Gablehouse
Robert Gunning
Robert Harland
William J. Kellar
Marion Lang
Edward Leonard
Samuel Maley
Sherwin Miller
Harold Nylander
Frederick P. Storke
Larry R. Travis

COLORADO BETA, University of Denver
(March, 1951)

Oliver Lee Kingsley
Jean Koch.
Bonnie Krogh
Patrick Panfile
William Richter
Charles Robertson
William Scott

MISSOURI BETA, Washington University
(December 10, 1950)

Sefik Altay
William Earnest Ball
Loren Allen Benson
John Elwood Bertram
Joseph Edward Blanke, Jr.
Arthur Mark Bolsterli
George Mark Brelias
Charles Dean Briner
Thomas Maynard Burford, Jr.
William Frank Burggrabe, Jr.
Alfred Alden Cook
Leon Cooper
John Wallace Diesel
Robert Carrel Drews
Cornelius Eldert
August William Geise, Jr.
Richard Allen Glenn
Charles William Hargrave
Richard Lee Hedden
Edward John Heising
Robert Allen Hilker
Barbara Bartels Hixon
James Noble Holsen
Richard Charles Huning
George Montgomery Johnson
Herbert Edmond Johnson
Donald Michael Koch
William Koenig
Lester Herman Krone, Jr.
Gilbert Walter Meier
Gustav Mesmer
Paul Edward Muckerman
Max Martin Nathan
Edwin Raynold Rabin
Eugene Richard Rodemich
Charles Edward Russell
Frederick William Seubert
Donald Milton Stern
Morris Stern
Tadao Takayesu
Louis Joseph Tichacek
Cay George Weinel
Thomas W. Wood

NEW HAMPSHIRE ALPHA, University of New Hampshire
(November 16, 1950)

Rene H. Biron
Elinor J. Burleigh
Conrad Caron
Donald Childs
Edward A. Demers
John Dutton
Frank Gagliuso
Gilbert Gallant
William Goldthwaite
John Jacobsmeyer
Robert Leavitt
Robert Louttit
Robert L. Pease
Francis Penney
Harry Plumb

NEW YORK DELTA, New York University
(January 5, 1951)

Harold L. Berkowitz
Richard Chrenko
Robert F. Davis
Elinor Duncan
Marilyn Flom
Susan Fuchs
Miles A. Galin
Jerrold Goldman
Anita Goldrich
Walter Koppelman
Isaac Levi
Eleanore Lux
Frank Marasa
Willard Miranker
Theodore C. Salzman
Alfred Schulman
Aaron Shinbein
Lawrence C. Turk
Stanley Weitzner
Joseph Zapadinsky
William G. Zoellner

(May 12, 1951)

Jerome Sidman

NEW YORK EPSILON, St. Lawrence University
(December, 1950)

Robert Lambert
Mrs. Harold Lyon
Mary Plumer
Alison Provoost

(March 19, 1951)

Robert George Cromie
Jean Marie Kane

NEW YORK ETA, University of Buffalo
(April 2, 1951)

Charter Members
Howard W. Baeumler
Vernon N. Behrns
Albert G. Fadell
Lorraine W. Farber
Jean B. Feidner
Harry M. Gehman (old member)
Lillian Gough
Leonard J. Grzankowski
Roger G. Hill
Joseph E. Kist
Robert C. Kroeger
Sam J. LaMancusa
Charles J. Lindsay
Bernadine M. Lippert
Charles E. Maley
June M. McArtney
Norman Meyer
Harriet F. Montague
Mabel D. Montgomary
Lloyd J. Montzingo
Ruth B. Noller
Hadassah M. Nomof
V. Ellsworth Pound
Erick Reeber
Leonard R. Schaer
Paul J. Schillo
Edith R. Schneckenburger (old member)
Phyllis C. Schwartz
Esther Seiden (old member)
Harlan R. Stevens
David D. Strebe
Frederic C. Warner
Everett T. Welmers (old member)
Ina W. Welmers
Norma J. Wilson

NORTH CAROLINA ALPHA, Duke University
(October 31, 1950)

Blair Bowers
William Chapman
Thomas Edelbute
Alden B. Gorham
John W. Haskens
Joyce McAfee
Robert M. Price
Emily West

(May 8, 1951)

Neil R. Andon
Eugene Bernstein
W. D. Climenson
Thomas Cole
Lyle B. Connor
G. H. Coppala

Edmond Dewan
H. J. Dukes
Albert Erwin
C. C. Johnston
Eleanor Lake
Donn McGeihan
Douglas Montgomery
R. L. Padgett
Douglas Schafroth
Sidney Trundle
R. M. Tucker
R. V. Warden
Martha Woolery
Bill Wright

NORTH CAROLINA BETA, University of North Carolina
(Date of initiation not given)

H. Leroy Adams
L. P. Burton
Maurice Clayton
Richard Robney Croxton
Meyer Dwoss
John Jones
David Kerley
Peter Kotsch Kloeppel
Mary Nunn Morrow
Thomas L. Nabors
Jack Padgett
Tullio J. Pignani
Samuel Jackson Scott
Frank Wilhelm Stallard
Jeron Thomas Terrell

OHIO ALPHA, Ohio State University
(May, 1951)

Walter Albrecht
Beryl Cloffelter
Basil Curnutte
Henry Diehl
Douglas Drake
Karl Eichhorn
John Garing
Otto Cleve Juelich
John Kettelle
R. Conway LeCraw
Alfred Baker Lehman
Curt A. Levis
Walter Loewenstein
W. C. Lowry
Barbara Manning
Sol Matt
Norman Pomerantz
Richard Sapp
Richard Shamel
Pater Stephan
Robert Thompson
Claude Walston
Richard Zemlin

OHIO GAMMA, University of Toledo

Donald Ewing
James F. Machen
Jacquelyn McLain
Phillip Miller
Richard Pio
Steven Szabo

OHIO DELTA, Miami University
(November 2, 1950)

Allan Branch
Kenneth Brinkman
Marilyn Copeland
Margaret Dennison
Francis Edmunds
Donald Emerick
J. Stanley Fouch
James Harris
Samuel Harris
Robert Hefner, Jr.
Edwin Hunger
Eleanor Keffer
Kenneth Last
Edmund Lis
David Perry
Phyllis Rinderknecht
Robert Rowntree
Richard Schmunk
Marylois Scrafford

(March 15, 1951)

Jack R. Webb

OKLAHOMA ALPHA, University of Oklahoma
(May 3, 1951)

Bill Atkinson
Kenneth Lee Austin
Jean Marie Baldwin
Richard Park Bland
Carl Edward Bleil
Tom Kelman Boehme

William Marvin Blinker
Yu Why Chen
Walter Dale Compton
Thell Lu Hilburn
Robert Draper Hill
John Edward Hoffman
Chia Ying Hsueh
Barney Lawrence King
Anthony Edward Labarre, Jr.
Mark Aldridge Melton
George Elva Neal
George Richard Pickett
Frank Raunikar
Charles William Reich
Norman Gene Rhode
Wayne Edward Richardson
Donald Ray Rutan
Howard Wesley Prier
Alva Taylor Stair, Jr.
Lyla Katherine Tisdale
Leon Tisdale
Ted S. Webb

OKLAHOMA BETA, Oklahoma Agricultural and Mechanical College

David L. Johnson
Arthur W. Liles
Galyn D. Pownell
Richard F. Stewart
David L. Weeks
Zenon S. Zannetos

OREGON ALPHA, University of Oregon
(May 4, 1951)

Kermit G. Clemens
Carolyn Diane Ford
Bruce A. Koppe
David D. Lanning
Calvin T. Long
Cyrus R. McAllister
Gerald F. Owsley
William J. Parker
Donald E. Robison
Sam C. Saunders
Robert J. Silva
James H. Skelton
Frank G. Snyder
Donald R. Stark
Jochanan H. Stensch
Karl R. Stromberg
John R. Toomey
LeRoy J. Warren
Thomas W. Williams

OREGON BETA, Oregon State College
(May 17, 1951)

Kenneth W. Andreson
Phillip Anselone
Christian G. Backman
Robert I. Beecroft
John V. Blankenbaker
Robert W. Brown
Burton C. Carlson
Arthur N. L. Chiu
William R. Cromwell
Monte V. Davis
Glen E. Dillon
Sterling Ditsworth
David LeRoy Espey
Nancy Ann Gentle
John M. Gerhauser
William W. Gribble
Dale M. Holme
Dale E. Kirk
Gail Elaine Kromer
Walter M. Lovett
Charles P. Luehr
William Maillard
Don G. McKinstry
Marshall W. McMurran
LeVern E. Marsters
Donald R. Miedaner
Henry T. Norton
Gerald S. Racanelli
Ronald R. Runge
John W. Schultz
Robert F. Sharp
Robert G. Snyder
Warren C. Steele
Robert S. Steffanson
Matti S. Siukola
Sirkka Liisa Siukola
Ralph A. Sundberg
John Sur
George C. Turrell
Richard L. Whitely
John D. Worthman

PENNSYLVANIA ALPHA, University of Pennsylvania

Fred W. Aron, Jr.
Anita Bredt
Fu-Ho Chan
Robert B. Dickson
Sheldon J. Einhorne
David Eugene Field
Bruce S. Fisher
Lee Frantz
Lawrence Frishkopf
H. Newton Garber
Walter Hess Leser
David J. Lobel
Pinchas Mendelson
John M. Miller
Thomas Mott
Bernice Newman
Alexander LeF. Pugh III
George Rosen
Girard K. Rosenblum
Judith Richman
Harvey S. Safren

Elizabeth Schwarz
Thomas Scott
Charles C. Sweley
Matthew London
James S. McCaughan
Donald R. McIlvain
Werner B. Teutsch
Herbert J. Vassian
Kurt F. Wisebrun
Milton Wollman

PENNSYLVANIA BETA, Bucknell University
(December 4, 1950)

Eugene L. Baker
Dorothea Bohling
Elinor Childs
Fred E. Cloud
Robert A. DeGroot
Margaret L. Garrett
William G. Hendrixson
James E. Hole
Joan G. Hoshauer
Rose Hostetler
Francis C. Huber
Paul M. Hurst, Jr.
Kirk Kazarian
Martin W. Kwasnoi
Rocco L. Mascioli
Edwin R. Mignell
John G. Morrison
Richmond S. Murdough
William L. Mickolls
George Polinko
Eugene B. Price
Samuel R. Pulford
Rosemary Scheerer
Jerome C. Sechrist
Donald J. Skovholt
Daniel Woodside

VIRGINIA ALPHA, University of Richmond
(November 1, 1950)

Sterling Clark
Grace Collins
Marian Jeffries
William F. Herget
William C. Martin
Willard E. Meador

(May 2, 1951)

James L. Judson

WASHINGTON BETA, University of Washington

Richard Byrne
Ted R. Jenkins
James McKay
Arthur Moskin
Douglas Newton
Gerald S. Rogers
Robert J. Wisner

WISCONSIN ALPHA, Marquette University
(April 30, 1951)

John E. Callan
Mrs. Dale S. Godbarsen
L. Beverly Hauk
Leonard F. Herkowski
Bencion Kampos
Carl G. Koch
Willard E. Lawrence
John W. Lindner
Matthew A. McCormick
John E. Quinlan
Fred Ray
Dave R. Rhyner
Dave A. Rux
Walter P. Rynkiewicz
Jerome J. Soboleski
Dorothy J. Stodola
Terrance E. Utz
Felix J. Veliath

WISCONSIN BETA, University of Wisconsin
(October 12, 1950)

Roy C. Alverson
Edward H. Batho
Chris C. Braunschweiger
Jean-Francois Canu
Robert C. Carson
John O. Danielson
Stephen A. Dickinson
Ralph J. Eckert
Trevor Evans
Walter A. Harman, Jr.
William Hemmerle
Melvin Henriksen

Bruce L. Lercher
Eugene T. Leverentz
Ely S. Levinsky
Clifford L. Maier
Orville J. Marlowe
Gertrude Nissenbaum
William H. Peirce
Duane A. Rohde
Lee A. Rubel
Jean H. Snover
Willia Soper
James E. Thompson
Roger N. Van Norton
Peter D. Welch

(May 24, 1951)

John F. Bartholomew
Robert P. Bell
Colleen Byrne
Leslie W. Gunter
Eugene Hough
Millard Johnson
Margaret H. Jolly
William J. Ochalek
Roger B. Russell, Jr.
Mary Tsingou
Peter H. Wackman
David B. Wittry

INITIATES, ACADEMIC YEAR 1951-1952

CALIFORNIA ALPHA, University of California, Los Angeles
(January, 1952)

Fred Baskin
Jordan J. Bloomfield
Charles E. Buie
Enrique Cansado
Noriko Chiwaki
Dennison A. Curtiss
Richard L. Dunn
Martin Emil Fuller II
Kaspar P. Grimm
Eugene Levin
Barrett O'Neill
Eugenia Houg Kiser
Richard E. Tuck
Maria Weber
David F. Weinberg

CALIFORNIA BETA, University of California, Berkeley
(December 18, 1951)

Robert Lee Besag
Robert S. Freeman
James B. Herreshoff
Nasrollah Javahertarash
Jan Kalicki
John Killeen
Arnold M. Matscke
Richard Montague
Leon Orloff
Donn B. Parker

DELAWARE ALPHA, University of Delaware
(Winter, 1951-52)

Vincent Bacchetta
Fred Q. Barnett
John H. Barrett
Girard Golden
Elam K. Hertzler
Verna Frances Lair
Donald B. Clement
Morris Glatt
John B. Lyon
Esther Simon
William V. Smith

IOWA ALPHA, Iowa State College
(Fall, 1951)

Sigurds Arajs
Marts D. Blue
Mary Ethel Buxton
Elaine Kobylanski Byrd
Bruce E. Deal
Edwin Gatz, Jr.
Lawrence Heyerdahl
Arthur Karwath
Gary Meisters
Kalliope Papantonis
Howard Peterson
Stanley Petrick
James Talboy, Jr.
Robert Tweedy
Martin B. Wilk
Joan Wilson