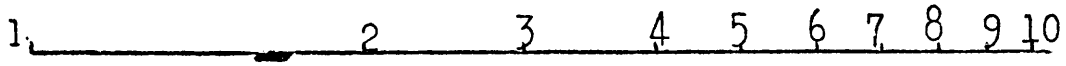
THE MATHEMATICAL LOG

of

THE NATIONAL HIGH SCHOOL AND JUNIOR COLLEGE MATHEMATICS CLUB

MU ALPHA THETA



VOL.I, no.1

A LETTER FROM THE PRESIDENT

Dear Members of Mu Alpha Theta chapters:

With the first issue of our bulletin, it gives me great pleasure to welcome each of the 74 chapters which joined Mu Alpha Theta last spring. May I express the hope that each member will not only feel a sense of pride in having met the vigorous standards laid down for admission, but will, also, make full use of the opportunities provided by membership in Mu Alpha Theta. Ours is not intended to be only an honor society, but rather an active organization whose sole purpose is to show those who have demonstrated superior ability in mathematics that mathematics is full of joys and pleasures, and that its pursuit as a field of study can be most rewarding.

For this reason, our constitution provides that each chapter must hold regular meetings; at the minimum, there should be one meeting every month. It is our plan to provide you with concrete suggestions on suitable programs for such meetings. Topics for such meetings should preferably be selected from fields of mathematics not ordinarily covered in high school courses, yet of sufficient simplicity to appeal to and interest juniors and seniors in high schools. After having had the opportunity to talk to various high schools and junior colleges... including some of our Mu Alpha Theta chapters... on mathematical topics, I have found that topics from number theory have proven to be the star attraction. For this reason, I have included a list of such topics from number theory which I hope you will find suitable for your chapter meetings. Your governing council has just appointed a committee on programs consisting of three exceptionally well qualified mathematicians from industry, college, and high school, respectively, whose task it will be to make up additional lists of suitable programs.

Your national officers have , also, expressed the hope that Mu Alpha Theta members will insist on participating in the National High School Mathematics Contest, which will be given regularly every spring. In order to become acquainted with the stimulating problems included in these tests, Mu Alpha Theta chapters are urged to work all problems in the recent contests as part of their activity program to prepare themselves for next year's contest. Old contest booklets can be obtained by writing to PROFESSOR SALKIND, POLYTECHNIC INSTITUTE OF BROOKLYN, 88 LIVINGSTON ST., BROOKLYN 1, NEW YORK CITY, NY. Let us be sure that Mu Alpha Theta chapters will rank at the top in next year's contest! For another challenging selection of problems, read the very interesting lead article in the June-July issue (1957) of the American Mathematical Monthly.

Your governing council is conscious of the tremendous responsibility which it has assumed in furthering the aims for which Mu Alpha Theta has been organized. Only by the active cooperation of each chapter under the guidance of the faculty-sponsor can our goals be realized. The critical shortage of scientifically trained students... a problem which by many has been called the most critical facing our nation... is always traced back to inadequate preparation in mathematics. Let us hope that Mu Alpha Theta by furthering interest in mathematics will make a significant contribution towards relieving this problem. I earnestly urge each member to make the most of his membership by actively participating in chapter meetings. You will not regret it!

(signed)

Henry L. Alder,
President, MU ALPHA THETA,
(Department of Mathematics, University of California, Davis, Calif.)

TOPICS FROM NUMBER THEORY SUITABLE FOR TALKS AT

MU ALPHA THETA CHAPTER MEETINGS

References listed below are taken from the following texts:

1. J. V. Uspensky and M. A. Heaslet, ELEMENTARY NUMBER THEORY, McGraw-Hill Book Company, Inc., New York and London, 1939.

2. Burton W. Jones, THE THEORY OF NUMBERS, Rinehart and Company, Inc., New York City, 1955.

3. Harry N. Wright, FIRST COURSE IN THEORY OF NUMBERS, John Wiley and Sons, Inc., New York City, 1939.

The first four topics listed below can be covered easily in one period; the last one requires at least three periods:

TOPIC 1: On Prime Numbers including Unsolved Problems concerning Primes. (Uspensky and Heaslet, Chapter IV, sect on II, page 85, and sections 15 and 16 , pages 92-94.)

TOPIC 2: Scales of Notations (Uspensky and Heaslet, chapter I, section 4, Chapter I, problem 16 on page 23.)

TOPIC 3: The Egyptian Method of Multiplication (Uspensky and Heaslet , Chapter I, problem 16 on page 23)

TOPIC 4: Polygonal Numbers (Espensky and Heaslet, chapter I, section 4, pages 9-11, also include problems 7-11 on page 22.)

TOPIC 5: Simple Continued Fractions (Wright, chapter II, sections 12-16, pages 15-25, also include problems 1-11 on page 19 and problems 1-7 on page 21; or Jones, chapter 4, sections 4.1-4.5, pages 76-89)

PROBLEMS JUST FOR FUN

```
    D & J
A N D R E E
  S E N D
C H E E R
```

Each symbol stands for a specific digit . $E^2 = H$.

The addition is correct. Find the digit problem.

* * *

A boat company has a regulation that it will not accept baggage whose largest dimension is more than one yard. John's gun is 60 inches long and can not be taken apart or shortened in any way. How can John pack this gun so it will be acceptable to the boat company as baggage?

MATHEMATICIANS ARE IN GREAT DEMAND

One of the really far reaching decisions facing students is the choice of a career. Since all of you are interested in mathematics and adept in it, you probably wonder about careers in mathematics.

The openings today are fabulous in all branches of mathematics. Most companies are particularly eager for mathematicians who can program high speed computers. It is estimated THAT 50,000 WILL BE NEEDED IN THE NEXT FIVE YEARS!

In order to get really up to date information, we wrote to a number of big companies selected at random. Most replied with a letter, and some with a pamphlet. Concentrating as much information as possible in a limited space, I have selected a few short quotations on opportunities, training, and duties of mathematicians. Here is a table of starting salaries (and these are typical ones), although some companies are reluctant to quote salaries because they vary with individual ability and experience; also most of them expect to be offering higher salaries in 1958. This gives you a brief glimpse of the wonderful and varied career opportunities in mathematics.

	BEGINNING SALARIES per month		
	B.S. degree	M.S. degree	Ph.D. degree
Douglas Aircraft Co. Santa Monica, Calif.	$ 435-445	525	690
Vitro Laboratories West Orange, N.J.	476	520	600
Sandia Corporation Albuquerque, N.M.	435	500	675
Lockheed Aircraft Marietta, G .	475	500	585
Radio Corporation of America Patrick AFB, Fla.	400	600	[illegible]
Army Ballistic Missiles Agency Redstone Arsenal, Huntsville, Ala.	374	445	586
Burroughs Detroit, Mich.	400-450	450-500	
U.S. Civil Service Potomac River Nav. Command	340-445		
International Business Machines	(not specified except "among top for industry"		

	BS degree	MS degree	Ph.D degree
Convair Aircraft Corp	400	500-550	
Dept. of Army (Quartermaster)			$964
Army Map Service	374-660		

SALARIES FOR PROFESSOR OF MATHEMATICS:

	for 9 months
Alfred University, Alfred N.Y.	$6000
University of Arizona	$6000
Ball State Teachers College, Muncie, Ind.	$6000
Bowdoin College, Brunswick, Maine	$4500
Numerical Analysis Research,UCLA, Los Angeles	$2000 (half-time)
University of Colorado, Boulder, Colo.	$4700-6600
University of Conneticut, Storrs, Conn.	$5160-7560
Cornell Univ., Ithaca, N.Y.	$5250-7000
Georgia Institute of Technology,Atlanta	$9000
Idaho State College	$7500-8000
Southern Illinois University	$7200-9600

(NOTE: These colleges and universities are not meant to be the highest but typical of their area)

QUOTATIONS FROM LETTERS RECEIVED FROM INDUSTRY
about employment of mathematicians

DOUGLAS AIRCRAFT CO.: " The demand greatly exceeds the supply. The opportunities for mathematicians in industry have not been adequately publicized."

VITRO LABORATORIES: " Activities in data reduction involve a wide range of subjects and techniques of applied mathematics: numerical and graphical methods, real and complex function theory, probability and statistics, linear programming, wave analysis, and operational calculus. The staff analyzes raw data, recommends or performs optimum reduction procedures, and presents results in accordance with customer requirements."

SANDIA CORPORATION: "This number (200 Ph.d's a year) can not possibly supply the demand that is needed in all of the various research activities. The mathematician at the doctorate level can find outlet in almost any field of endeavor."

METROPOLITAN LIFE INS.: " The actuary may be regarded as a business man with a mathematical background. ...The actuary plays a major role in determining the benefits or types

of coverage his company will offer.'

GENERAL ELECTRIC CO.: " Operations research.... Some better known uses have been made in devising bombing patterns, [illegible] developing tactics for submarine warfare, scheduling airliners or oil tankers, locating stores or factories, scheduling the blending of gasoline, and deploying salesmen. These uses require not only many of the techniques of modern mathematics, but, also, the philosophy of modern mathematics."

CONVAIR AIRCRAFT: " I would like to help encourage high school students to pursue a career in mathematics. The opportunities available for math graduates in the aircraft and missile industry are becoming more attractive.'

INTERNATIONAL BUSINESS MACHINES: " Advising on the use of their I B M electronic data processing computers, I personally consult with these customers and analyze their scientific and technical problems for solution by IBM. Occasionally, I'm asked to write papers, and give talks and demonstrations on electronic computers.' John Jackson.

There are two pamphlets put out by the Federal Government which should be of particular interest to the girls who are members of MU ALPHA THETA. They are very inexpensive and are loaded with valuable information. They are:

> Employment Opportunities for Women Mathematicians and Statisticians. Womens Bureau Bulletin No. 262, U.S. Dept. of Labor, Washington Government Printing Office, 1956. 6-37 pages. 25 cents.
>
> Is "Math" in the Stars for You?. Womens Bureau Leaflet 28, U.S. Dept. of Labor, Washington, Government Printing Office, 6 pages. 5 cents.

Also, The University of Oklahoma has printed leaflets on mathematics and all other college majors explaining opportunities, type of work, kind of college courses required and other information about the major. If you are interested in the leaflet on mathematics ... or anyother... they are free by writing to GEORGE CHURCHILL, DIR. OF PUBLIC RELATIONS, THE UNIVERSITY OF OKLAHOMA, NORMAN, OKLAHOMA and specifying which leaflets you wish. These are strictly pre-college counseling in the college major.

* * * *

So many enthusiastic letters come in from chapters coast to coast, that we wished you could share them all. Here are a few excerpts of special interest:

> HACKENSACK HIGH SCHOOL CHAPTER, HACKENSACK, NEW JERSEY
>
> " Our principal presented the Mu Alpha Theta certificates at an awards assembly..... One of the most interesting and influential films sent out has been one by the Worcester Institute of Technologycalled ' Bridges to the Future:. It describes life and work at a technological school.....We hope to go on some field trips this fall to see plants and buildings, where there is much geometry or electronics in evidence. We've had some of the programs on your list:

Perfect numbers, mathematical Puzzles, Number Systems with special emphasis on Binary and Duodecimal systems, Map Making (from the National Geographic Magazine), Trachtenberg Arithmetic and other topics developed by pupils."

Helen St. J. Clarke, advisor.

WAUKESHA JUNIOR SENIOR HIGH SCHOOL, WAUKESHA, WISCONSIN.

" We do appreciate the privilege of being a charter member, and we thank you for the publicity sent to our local paper. We have an interested and active chapter. "

Fannie Hopkins, advisor

MORRIS HIGH SCHOOL, MORRIS, ILLINOIS.

" The charter members imposed upon themselves and other members to be the requirement that each must present to the group a full discussion of a mathematical topic or thought which was entirely new to the group. Some of them took two hours to make a presentation. Altogether, we used about 8 hours for this step of initiation. They felt that it did each of the group a great deal of good... not only their own but each other's report."

Nellie M. Johnston, advisor

HICKMAN HIGH SCHOOL, COLUMBIA, MISSOURI

" Thanks for the certificates. They were presented officially by the President of the University of Missouri chapter of Pi Mu Epsilon to the newly elected chairman of the group, Alicia Ewing, who was the author and director of the Assembly program following the presentation. In this assembly, the Mathematics department awards little trophies to the four Seniors exemplifying ability in Readin', Ritin', 'Rithmetic and Radiance (the 4 R's) and then crowns a member of the Club as St. Pat's Queen... one who best exemplifies the 4 R's."

Nellie M. Kitchens, advisor,
National Governor of M A Θ.

MORE PROBLEMS JUST FOR FUN

Your chapter advisor decided to drive from your high school to Juneau, Alaska and return by same route. Her average speed going is 30 m.p.h.. Her average speed on the return trip is 60 m.p.h.. What is her average speed for the entire trip? (NOTE: The answer is not 45 m.p.h.!)

What would her average speed have to be on the return trip to average 60 m.p.h. on the round trip?

Each integer after the first in a sequence of integers is formed by adding one to twice the previous integer. The first integer is one. Find the tenth integer in the sequence. In notation: $U_1 = 1$, $U_{n+1} = 2U_{n-1}$, find U_{10}.

(Mu Alpha Theta is grateful to The University of Oklahoma for cutting stencils and mimeographis this Vol I, No I of our MATHEMATICAL LOG)

THE MATHEMATICAL CAME OF HEX
by
Martin Gardner

(reproduced in the MU ALPHA THETA bulletin with the special permission of SCIENTIFIC AMERICAN magazine from their July, 1957 issue.)

It is something of an occasion these days when someone invents a mathematical game that is both new and interesting. Such a game is Hex, introduced 15 years ago at the Niels Bohr's Institute of Theoretical Physics at Copenhagen, Denmark. Hex may well become one of the most widely played and thoughtfully analyzed new mathematidal games of the century.

In 1949, Aage Bohr, son of Niels, introduced the game at the Institute for Advanced Study at Princeton, New Jersey, where it quickly captivated the students of mathematics both at the Institute and at Princeton University. The game was commonly called 'John", because it was so often played on the hexagonal tiles of bathroom floors.

Hex is played on a diamond shaped board made up of hexagons (see Illustration I). The numbet of hexagons may vary, but the board usually has 11 on each edge. T o opposite sides of the diamond are labeled "black"; the other two sides are 'white".The hexagons at the corners of the diamond belong to either side. One player has a supply of black pieces; the other, a supply of white pieces. The players, alternately, place one of their pieces on any one of the hexagons, provided the hexagon is not already occupied by another piece. The objective of "black" is to complete an unbroken chain of black pieces between the two sides labeled "black". "White" tries to complete a similar chain of white pieces between the sides labeled 'white".

The chain may freely twist and turn; an example of a winning chain is shown on Illustration 1. The players continue placing their pieces until one of them has made a complete chain. The game can not end in a draw, because one of the players can block the other only by completing his own

chain. These rules are simple, yet Hex is a game of surprising mathematical subtlety.

Readers who would like to try Hex are advised to make mimeographed copies of the board in Illustration 1. The game can be played on these sheets by marking the hexagons with circles and crosses. A Chinese checker board with four star points deleted is convenient.

One of the best ways to learn the subtleties of Hex is to play the game on a board with a small number of hexagons. When the game is played on a two-by-two board (four hexagons), the player who makes the first move inevitably wins. On a three-by-threeboard, the first player may win easily by making his move in the center of the board (See illustrations 2 and 3). There is no way in which his opponent can keep him from winning on the third move.

On a four-by-four board, things begin to get complicated. The first player is sure to win if he immediately occupies any one of the four hexagons numbered in illustration III. If he makes his opening play elsewhere, he can be defeated. An opening play in hexagon II or III ensures a win on the fifth move; an opening play in hexagon I or IV, a win on the sixth move.

On afive-by-five board, it can still be shown that, if the first player immediately occupies the hexagon in the center, he can win on his seventh move. On larger boards, the analysis becomes enormously difficult. So far as I know, no one has fully analyzed the possibilities in a game of Hex played on a six-by-six board. Of course, the standard 11-by-11 board introduces such an astronomical number of complications that a complete analysis seems out of the question.
It is for this reason that the game theorists find Hex particularly interesting.

(illustrations on next page)

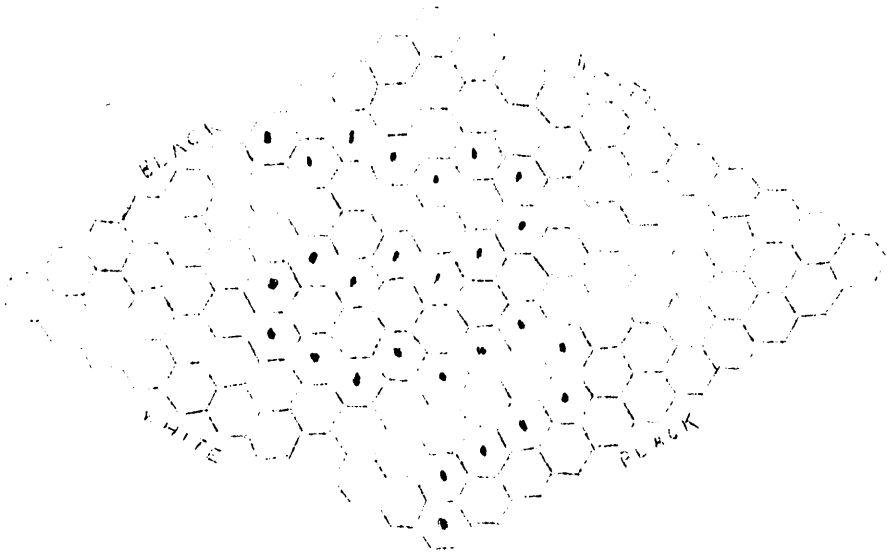


Illustration 1

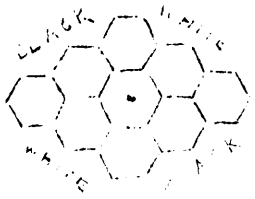


Illustration 2

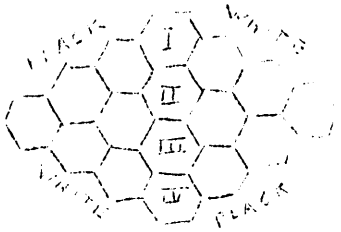
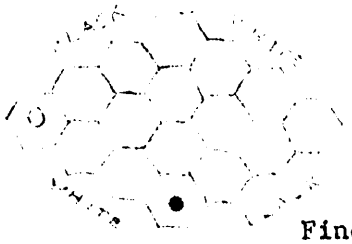


Illustration 3

STILL MORE PROBLEMS FOR FUN!

Six points are placed on a square, one at each corner and one at the midpoint of each vertical side. A seventh point is placed at the center of the rectangle formed by the uppermost four points (not the center of the square). Is it possible to connect the seven points without lifting your pencil from the pqper and by using just three continuous line segments?

* * *



Find the first move that will insure a win for white.

* * *

When the digit 2 is removed from the end of the number 105263157894736842 and placed in front so as to form the number 210526315789473684, the result is twice the original number. Can you find a number ending in 4, such that when the number 4 is removed from the end of the number and placed at the beginning, the result is four times the original number?

* * *