

THE MATHEMATICAL LOG

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Ten Cents and Some Spare Time

Many of these puzzles are culled from Martin Gardner's excellent *Mathematical Carnival*.

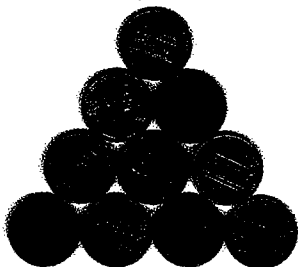
Put eight pennies in a row.



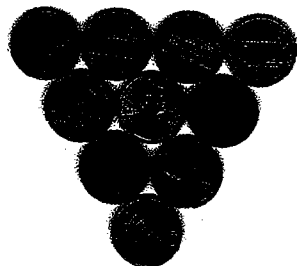
Convert them to four stacks of two pennies each by making four jumps. On each jump a single penny jumps in either direction over exactly two other pennies (a stack of two pennies or two single pennies) and lands on some other single penny.

Got that? Try ten pennies. How about $2n$ pennies?

Form a ten penny pyramid like so:

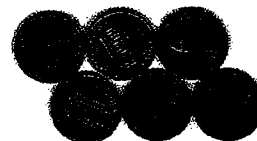


Invert the pyramid in as few moves as possible. A 'move' consists of sliding (no lifting) a penny from its location to a new place which is firmly determined by its touching two other pennies. Your new pyramid should look like (ok, not exactly like this; I moved the pennies around so you couldn't cheat your way to the answer):

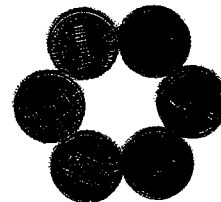


How many moves does it take to invert a 15-penny pyramid? A 21-penny pyramid? An $n(n-1)/2$ penny pyramid?

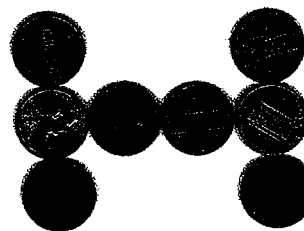
Now take six pennies and form a rhombus like this:



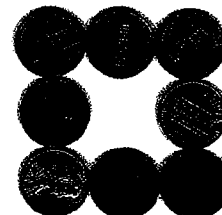
Using three moves, using the same rules as with the pyramid, convert the rhombus into a hexagon:



Moving from a triangular grid to a square one, convert this figure



to this one,



News and Announcements

•National Convention '00

The 2000 Mu Alpha Theta Convention will be in San Diego, California. The Convention will run from July 26th to July 31st. For those who have never attended a national convention, it is an excellent opportunity, not just to learn mathematics from the speakers and the contests, but to meet other students and teachers from around the country. *Editor's note: I attended four conventions as a student, and throughout a high school math 'career' which covered nearly a hundred tournaments and three trips to the Math Olympiad Program, I didn't enjoy any other math event more than I did the national conventions. Furthermore, last year my wife and I were moving after four years in New York. We chose our new location not by jobs or family, but by trying to find a beautiful, wonderful place to live. We live thirty miles east of San Diego now, and every day is better than the day before. Come see why.*

Details for the convention are on the Berkeley Prep website:

www.berkeleyprep.org/activity/upper/math/nationals.htm

•State and Regional Meetings

The Texas State Mu Alpha Theta Convention will be held on February 11-12 at The Woodlands High School in Woodlands, TX. For more information contact Barbara Collins at the Woodlands High School.

•MAΘ Website

Check out the National office website at www.mualphatheta.org for all the latest information from the national office. Chapters with their own websites, please contact the Math Log and let us know where you are!

•Student Articles

If there are any budding mathematical writers out there among our student readers, please submit articles to the Mathematics Log for publication. Please send all articles to the National Office (address below).

The Mathematical Log

Volume 44 Number 1, February 2000

The *Mathematical Log* is the official publication of Mu Alpha Theta, national high school and junior college mathematics honor society and mathematics club federation. Founded in 1957 by Richard and Josephine Andree, Mu Alpha Theta is co-sponsored by the Mathematical Association of America (MAA) and the National Council of Teachers of Mathematics (NCTM). Correspondence may be directed to Mu Alpha Theta National Office, 601 Elm Ave., Room 423, Norman, OK 73019, email: matheta@ou.edu or to Log editor Richard Rusczyk, 20901 Japatul Road, Alpine, CA 91901, email: rrusczyk@yahoo.com
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What Do You Want?

I'm open to suggestions for the *Mathematical Log*. What would you like to see? More interesting mathematics? History of mathematics? Applications? Articles on education? Philosophy of science and mathematics? Let me know what you'd like to see and you'll likely get more of it! Send your comments to:

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√ *At the Root of it All*

Deborah S. Patonai, Activities Editor

Every summer at the National Mu Alpha Theta Convention, brilliant Mu Alpha Theta members compete for national titles on topic tests, on written and ciphering contests, on chalk talks, and on math bowls. In addition to these coveted prizes, a select few graduated senior members vie for the prestigious Kalin Award bestowed upon the outstanding MAΘ member. At The Root of It All is pleased to honor the deserving 1999 recipient of the Kalin Award, Joshua Peters.

A hard-working, determined, and honest young man, Josh Peters from Lafayette High School in Lafayette, Louisiana, is admired by the entire school community. Enrolled in the gifted academic program throughout his high school career, Josh distinguished himself as the best. Not only did he maintain a perfect 4.0 in the most difficult curriculum possible, but he also achieved the highest score in the district on the PSAT/NMSQT and SAT. While Josh is blessed with many special talents and gifts, he knows how it feels to work hard for what he gets. He puts all of his energies into his work.

Foremost among Josh's gifts is his exceptional aptitude and love for mathematics. He was always several years ahead of his schoolmates in the mathematics curriculum and he always did an enormous amount of self-study to be even more advanced. Not only did he take every math course available at his school, he even enrolled in Differential Equations at his local university and made the highest grade in the class. Reflecting this influence of a background in and aptitude for mathematics, Josh hopes to pursue theoretical computer science and electrical engineering combined as a double major with mathematics at M.I.T. Ultimately, he hopes to conduct research in industry and become an adjunct faculty member at a university.

Competing at mathematics competitions has always been one of Josh's loves, and his talent has enabled him to win numerous awards locally as well as nationally. He received the highest score in his school on the AHSME and qualified for the AIME the last three years. He placed first in Calculus A and B not only at his state MAΘ conventions but also at the National MAΘ Convention as well. As one of only twelve students representing the state of

Louisiana at the American Regional Math League Competition, he earned the highest score on the team this past year.

In addition to his successes in mathematics, he is also very proficient on the computer and has done very well in numerous computer science competitions. The driving force on the three-man programming team that placed first in the state competition, Josh helped his team qualify for the national tournament in Washington, D.C. Besides the team's placing ninth at this elite competition, Josh was recognized for his outstanding score on the individual portion of the competition.

Josh's talents were not just limited to academics; he was also a dynamic leader in numerous organizations at school and in his state. He was selected to participate in Lafayette Junior Leadership, a leadership program sponsored by the Chamber of Commerce for only the most outstanding young people in his community. An active member of Key Club, Beta Club, Future Business Leaders of America, and the Science Olympiad, he contributed numerous hours.

However, Josh always seemed to find the time to devote to MAΘ. Serving as his MAΘ Chapter's Representative for Calculus and for Calculus II as well as his state's MAΘ president, Josh gained both skills and knowledge from his pursuit of mathematics and his leadership in MAΘ. "Mu Alpha Theta has affected me in ways that even my formal education has not," Josh explains. "I have learned to budget my time for the activities that I value and to coordinate a large group of people to complete a complicated task."

Organizing and preparing for the State Mu Alpha Theta Convention was definitely Josh's most demanding but favorite high school experience. "Competing and winning the most advanced individual divisions was exciting," Josh remembers; "but the great fellowship with other state officers and friends, the inside jokes, and the hours of preparation I put into convention are my fondest memories." Having helped with local math tournaments by writing contests and proctoring events had not adequately prepared Josh for the experience of running a state event. He and his

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BOOK REVIEW:

The Origin of Consciousness in the Breakdown of the Bicameral Mind

by Julian Jaynes

Review by Richard Rusczyk

Math teachers hear it in almost every classroom every year. "Why do we have to learn this?" Speaking of the quadratic formula or the double angle formula for sine or the Fundamental Theorem of Algebra, the asker is usually right to question the importance of the specific item being taught. The question, though, is misdirected. The specific formula is not so important as the training of the mind to reason. Mathematics, and to a somewhat lesser degree science, is ideal for this instruction. Once you have developed this capacity for reason, then you get to leave school and focus it wherever you like.

I chose *The Origin of Consciousness in the Breakdown of the Bicameral Mind* as an example of a particularly fascinating application of reason. The book certainly has nothing to do with mathematics and little to do with science, but I introduce it to Mu Alpha Theta students, as those who are among the most curious and intelligent in the country, because you will likely find Jaynes's thesis as fascinating as I do. Moreover, I'm still amazed that I made it through four years of high school and four years of Princeton without ever hearing his theories, despite the fact that Jaynes was a professor at Princeton while I was there.

The title gives a glimmer of Jaynes's work. Through an in-depth study of the human mind, ancient literature, ancient history, and piles of psychological studies, Jaynes delivers two revolutionary conclusions.

Consciousness is learned, not genetic, and is based on language. Jaynes precedes this bold claim with a discussion of what consciousness is versus what it isn't. He systematically dispels many common notions of consciousness as well as some errors made by prominent philosophers throughout history. Quite simply, consciousness isn't all it's cracked up to be. A daunting amount of what we do in our lives is done entirely unconsciously (in fact, though not mentioned in this text as the experiments were performed after it was written, evidence suggests that any conscious 'decision' to perform simple acts such as moving one's hand is preceded by at least 0.3 seconds of unconscious mental activity before any conscious awareness of a decision).

Much of the misunderstanding of the nature of consciousness stems from confusing it with perception. One philosopher argued with Jaynes "Are you trying to say that I am not conscious of you at this moment?" To which he answers that the philosopher certainly perceives Jaynes, but is more likely conscious of his own argument than conscious of Jaynes. Consciousness has very, very narrow bandwidth, particularly as compared to perception. We see, hear, feel, and smell much more than we are ever consciously aware.

Curiously, much of our most excellent activity is unconscious. Writings and speeches of great athletes, scientists, and performers all attest to not being entirely, or even partially, conscious of their actions or thoughts. Hours of carefully conscious thought and practice are merely honing the massive unconscious mind for performance or deliberation. Working on tests or playing sports, you've probably had this experience. You play better when you aren't concentrating on the mechanics of your actions. You sometimes find the answer to a perplexing problem while staring at the ceiling humming some silly song to yourself. Your mind is very, very active without need of your consciousness to direct it.

All this interesting information regarding consciousness notwithstanding, Jaynes never clearly puts forth a vision as to why mankind developed consciousness in the first place. He rests on the metaphorical nature of language framing the metaphorical nature of our consciousness, but his argument isn't entirely convincing (or I just need to think about it further). It's not clear that metaphorical concepts in language weren't developed after consciousness rather than the other way around as Jaynes seems to allege. Certainly natural selection had much to do with perpetuating consciousness (or the facile ability to learn consciousness, should Jaynes be correct in this assumption; it seems unlikely and even horrifying to consider the obvious experiment to test the notion); the Bible, for example, has copious evidence of persecution and wholesale slaughter of those who maintained their bicameral nature in a conscious society.

The discussions here are interesting, but not as convincing as his other revolutionary conclusion:

Humans were not conscious until around 1000 B.C.; before that time they had 'bicameral' minds. As some of you may well know, many mental activities are located specifically on either the right side or the left side of the mind. For right-handed people (henceforth I'll assume right-handed for ease of writing), speech is located in the left hemisphere

while such faculties as logic, face recognition, and song live in the right hemisphere. In Jaynes's bicameral man, the right hemisphere could also prompt hallucinations, usually auditory but sometimes visual. His evidence for this claim is the body of literature from ancient times as well as archeological finds of civilizations at pertinent periods.

His body of evidence in literature is primarily the writings of the Greeks and the books of The Old Testament in the Bible. According to Jaynes, the Iliad and The Old Testament clearly describe the functioning of bicameral people. A bicameral person lacking consciousness is driven by directives provided by instinct and those commanded to her by her gods, where her gods are the hallucinated voices of authority. Both the Iliad and The Old Testament are packed with instances of individuals being instructed by voices of their gods and both are notably (in literal translations) devoid of any instances of individuals doing anything we might call 'thinking'. No people of the early books of the Bible engage in introspection. They hear their voices, occasionally accompanied by visions, and act accordingly. The evolution of Greek literature through the Odyssey and on to later works as well as the writings in the later books of the Old Testament provide an outline of humanity's development of consciousness as the bicameral experiences faded.

Vestiges of bicameral humans live on to this day. Hypnosis provides evidence to the power of suggestive command which is somewhat like the experience bicameral man would have felt from his voices. Further still, schizophrenics experience hallucinogenic episodes very much like those bicameral humans would. They complain of an inability to think and a loss of self identity as their consciousness is crowded out and their mind is overwhelmed by the imperious voices directing their actions.

These examples are just a small slice of the mountain of evidence Jaynes uses to support his claim of the relative novelty of consciousness. While I still have a lot of thinking to do before I am convinced of his thesis of consciousness as a learned trait, I am compelled enough by his data on the history of man to believe he is probably right about humanity not being conscious before 1000 B.C. (at least not in the way we now experience consciousness). The dependence on voices, which were as real as any other voices, followed by the loss of these voices, certainly describes mankind's millennia of dependence upon idols, oracles, prayer, and other religious inventions.

Despite being written by an academic as opposed to an accomplished writer, the book is very readable, only rarely descending into erudite babble. Upon finishing the book, I can only wonder why these ideas haven't been given more room in the press, if not the classroom. He first portrayed his ideas before a wide audience in the 1960s, so it's not novelty which has kept them out of public discussion. Most likely it's his heretical hypotheses that have limited the penetration of his ideas into religious cultures around the world. Regardless, as were Darwin's claims a century before, Jaynes's observations have enough evidence behind them and are important enough to understanding the nature of human existence that they warrant much more detailed study. Perhaps someone will find a fatal flaw in his reasoning, though I suspect that as more ancient civilizations are studied (Jaynes confesses to not knowing Chinese well enough to include ancient China in his study), the body of evidence in support of his claims will increase rather than diminish.

I haven't nearly done this book justice in trying to distill 469 heavily researched pages into a handful of paragraphs. I only hope I've piqued your interest enough to check out his writings yourself. I've read on the order of 150 books over the last year and a half; *The Origin of Consciousness in the Breakdown of the Bicameral Mind* is by far the most thought-provoking. If nothing else, you'll likely be presented with a viewpoint of humanity you've not seen before.

You Think You've Got Problems

Student submissions to the problem corner of the www.mandelbrot.org website (The Mandelbrot Competition)

- 1) Three circles with radii 2, 3, and 10 are externally tangent to the other two. Find the radius of the circle circumscribed about the original three. (The circle which contains the original three circles and is tangent to all of them.)
- 2) Suppose that m lines are situated in the plane so that each line intersects exactly k others. Let $f(k)$ be the number of values of m for which this is possible. A) Determine $f(20)$. B) If $f(k) = 3$, what is $f(k^2)$?

Submit your solutions as suggested on the Mandelbrot webpage and feel free to challenge students around the country there with problems of your own.

At the Root of it All

...continued from page 3

sponsor met with two hotels several times to make specific arrangements for each event and each meal.

He prepared agendas and presided over monthly meetings with the state board to plan and to discuss the convention. Using his experience with the Gemini events from national conventions, he created a new team event for the first time in several years. Besides soliciting people to write four individual tests, seventeen topic tests, and three rounds of Ciphering, Hustle, and Gemini, he personally wrote the Computer Science topic test and many Gemini questions. However, running the actual convention was his most challenging task. Full of nervous excitement, he gave his opening address in front of more than one thousand mathematics students and their teachers. His "adrenaline rush did not drop even after the awards ceremony two days later," he recalls. "Even the lost sleep from late night tasks and meetings could not detract from my experience," he continues. "I had literally worked for hundreds of hours on this project, and I could not take greater joy than seeing it completed successfully. My service to Mu Alpha Theta gave me knowledge, leadership, friends, and memories that I will always take with me."

Josh is definitely a hard-working, dedicated, and courageous young man.

In addition to possessing dignity, respect, and intelligence, he has the desire, personality, and wit to succeed in whatever fields of endeavors he chooses. According to his MA Θ sponsor Amy Gremillion, "He has never faltered from the path of excellence, even though the way has never been easy. He is one of those rare people who have overcome every obstacle he encounters, but does so in a positive, mature, and responsible manner He is an inspiration to everyone who comes into contact with him."

Joshua Peters brings together intelligence and leadership, making him the perfect recipient of the Kalin Award. Congratulations, Josh, and best wishes on your college pursuits.

Ten Cents and Some Spare Time

...continued from page 1

Let's try a slightly tougher one. Start from five coins in a row, alternating heads and tails,

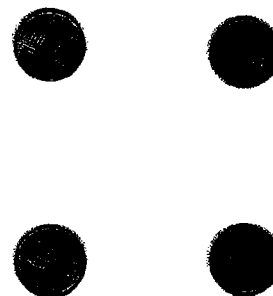


and in four moves make a row of three heads then two tails.



Here, a legal move consists of moving a touching pair of coins, either HT or TH, to another spot on the row. The moving pair cannot be flipped (so that HT becomes TH) or separated during a move, and the other three coins cannot be moved during the move.

From the bar bet variety of the problems comes four pennies in a square:



Changing the location of only one of these four pennies, create two straight rows with three pennies in each row.