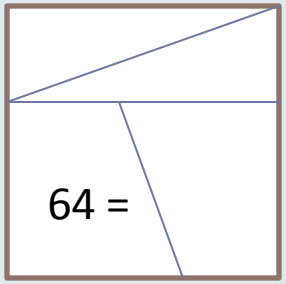
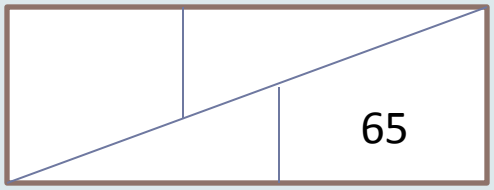
MAKE PUZZLES LESS PUZZLING WITH MATH:

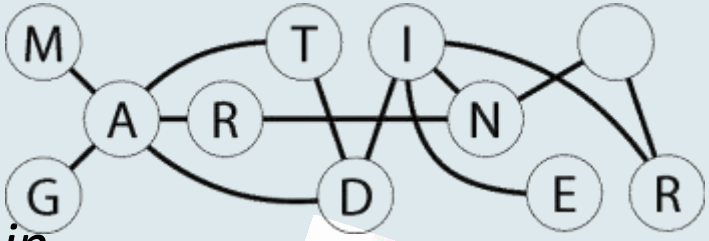
Why Does The Serial Number Appear Twice On Each Piece Of U.S. Currency?



Stuart Moskowitz
Humboldt State University
Arcata, CA 95521
1-707-445-5795
stuart@humboldt.edu

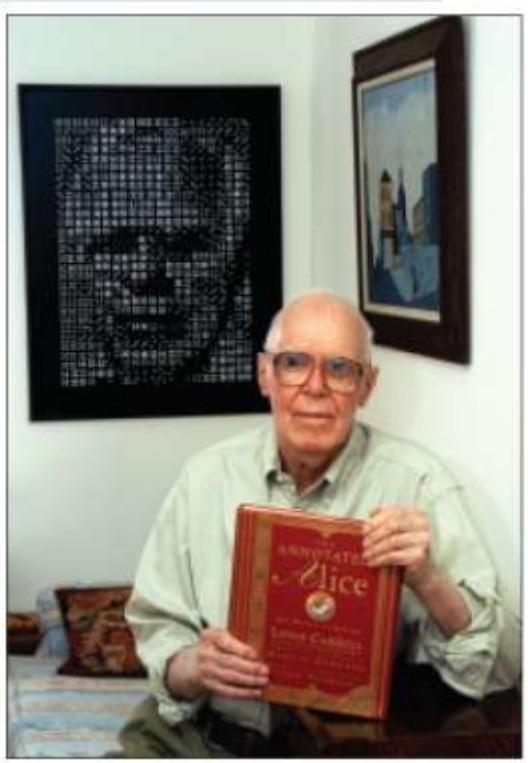


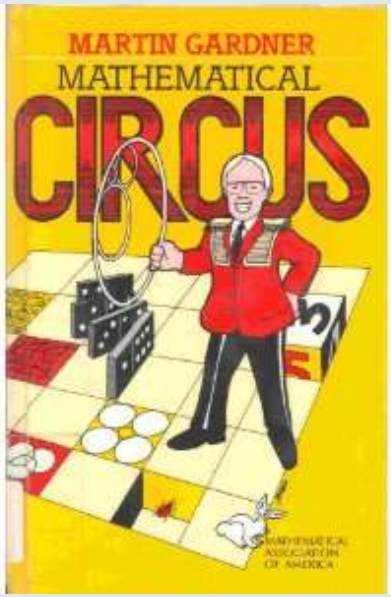
Dedicated to



1915-2010

"In fact, I believe one reason I am in Mathematics today is that I began reading Gardner's books and articles in Junior High and High School. Browse and Enjoy!"





Why Should We Study Puzzles?

- “We see how the average boy, who abhors square root or algebra, will find delight in working out puzzles which involve identically the same principles”

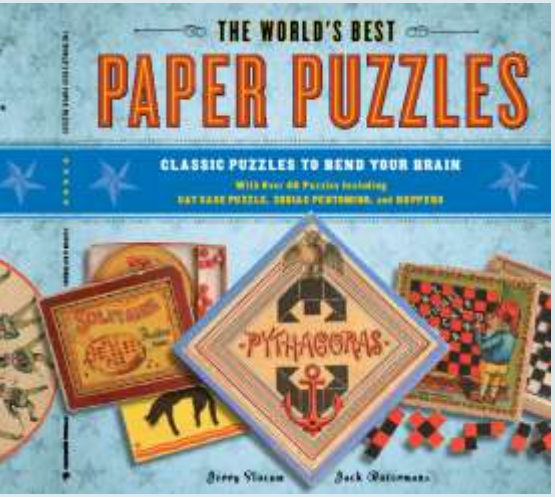
- “We could mention scores of noted scientist who like Tyndall, Huxley, Humboldt, Darwin, Edison, Bacon, Euler, Herschell and Proctor, were all pronounced puzzlists in their early days, so, upon axiom that the bend of the twig imparts the incline of a tree, it is safe to say that their early puzzle training gave the bent to their minds which in after years inclined them to grapple with problems of greater magnitude.”

Sam Loyd, master puzzlist (1841-1911)

http://www.samloyd.com/educational.html?id=educational

Jerry Slocum

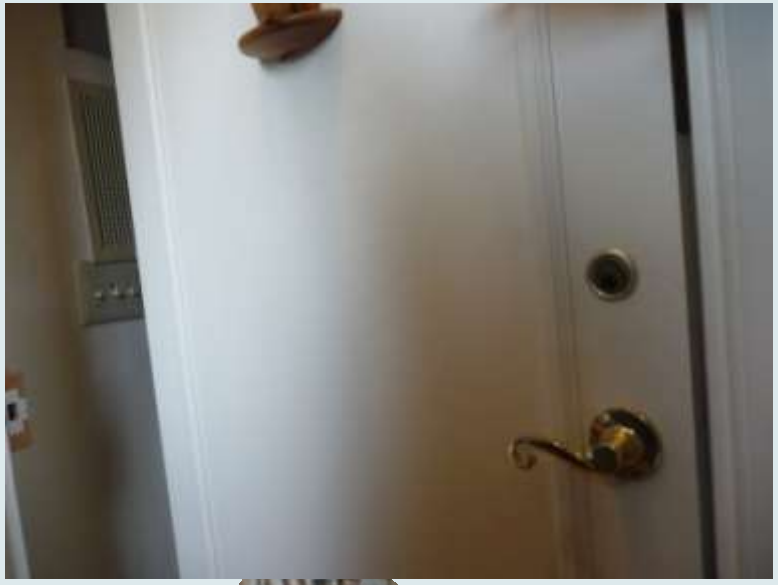
Puzzle collector
mechanical engineer
Hughes Aircraft, retired



I visited Jerry's puzzle museum on Feb 18, 2011. Here's the directions he emailed:

"…Our home is just 1.7 blocks South of Wilshire…"

Solve both doors to get Inside the Museum



Jerry Slocum is the first to Classify Mechanical Puzzles

Mechanical Puzzle Classification

Examples

Mechanical Puzzle Types (Example name is bold)

1. Put -Together Puzzles-Putting the object together is the puzzle.
   - 1.1 2 Dimensional assembly puzzles (**Tangrams**, Anchor, T, jigsaw,etc.)
   - 1.2 3 Dimensional assembly puzzles -Non-Interlocking (Soma,etc.)
   - 1.3 Miscellaneous put-together-(Instant Insanity, puzzle rings, etc.)
   - 1.4 Matchstick puzzles
2. Take -Apart Puzzles-Taking the object apart or open is the puzzle.
   - 2.1 Trick or secret opening puzzles -(**Puzzle boxes**, etc.)
   - 2.2 Secret compartment puzzles (Slopes, coins, etc.)
   - 2.3 Trick locks & keys
   - 2.4 Trick matchboxes (matchsafes)
   - 2.5 Trick knives
3. Interlocking Solid Puzzles-Disassembly & assembly to solve puzzle.
   - 3.1 Figural (Animals, objects, etc.)
   - 3.2 Geometric objects (Cube, etc.)
   - 3.3 3-D jigsaw puzzles
   - 3.4 **Burr puzzles**
   - 3.5 Keychain puzzles
   - 3.6 Miscellaneous interlocking solid puzzles
4. Disentanglement Puzzles-Disentanglement & entanglement to solve puzzle.
   - 4.1 Cast Iron & sheet metal puzzles
   - 4.2 Wire puzzles (**Chinese Rings**, etc.)
   - 4.3 String puzzles (Non-rigid disentanglement)
   - 4.4 Miscellaneous disentanglement puzzles

5. Sequential Movement Puzzles-Moving parts of object to a goal is the puzzle.
   - 5.1 Solitaire puzzles (Remove pegs, counters, etc. by jumping)
   - 5.2 Counter puzzles (Rearrange counters, pegs, etc. by jumping)
   - 5.3 **Sliding piece puzzles** (2D & 3D)
   - 5.4 Rotating piece puzzles (3D-Rubik's cube ,etc.)
   - 5.5 Maze & route puzzles
   - 5.6 Miscellaneous sequential movement puzzles (Tower of Hanoi, etc.)
   - 5.7 Mazes and Labyrinths for People

6. Dexterity Puzzles-Manual dexterity is primary to solve puzzle .
   - 6.1 Throw & catch (Cup & ball, etc.)
   - 6.2 **Rolling ball puzzles**
   - 6.3 Maze dexterity puzzles
   - 6.4 Miscellaneous dexterity puzzles

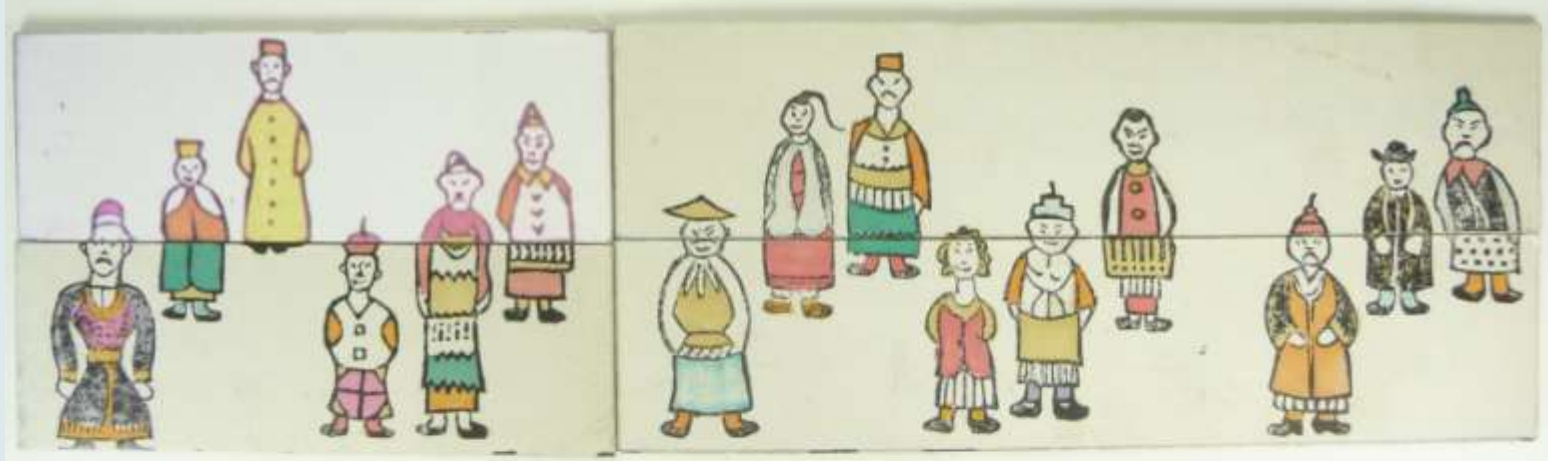
7. Puzzle Vessels - Drinking without spilling, or filling a vessel is the puzzle. (**Puzzle Jugs**, Bottom fill wine & tea pots, Pitchers, etc.)

8. Vanish Puzzles - The puzzle is to explain a vanished or changed image. (**Loyd's Get Off the Earth**, etc.)

9. Folding Puzzles - The puzzle is to fold a paper or hinged object, to form a specified pattern. (2D & 3D) (**Fifth Pig Puzzle**, etc.)

10. Impossible Puzzles - The puzzle is to explain how an object was made or why it behaves in a seemingly impossible way. (**Arrow thru bottle**, celt, etc.)

#8 Vanish Puzzles



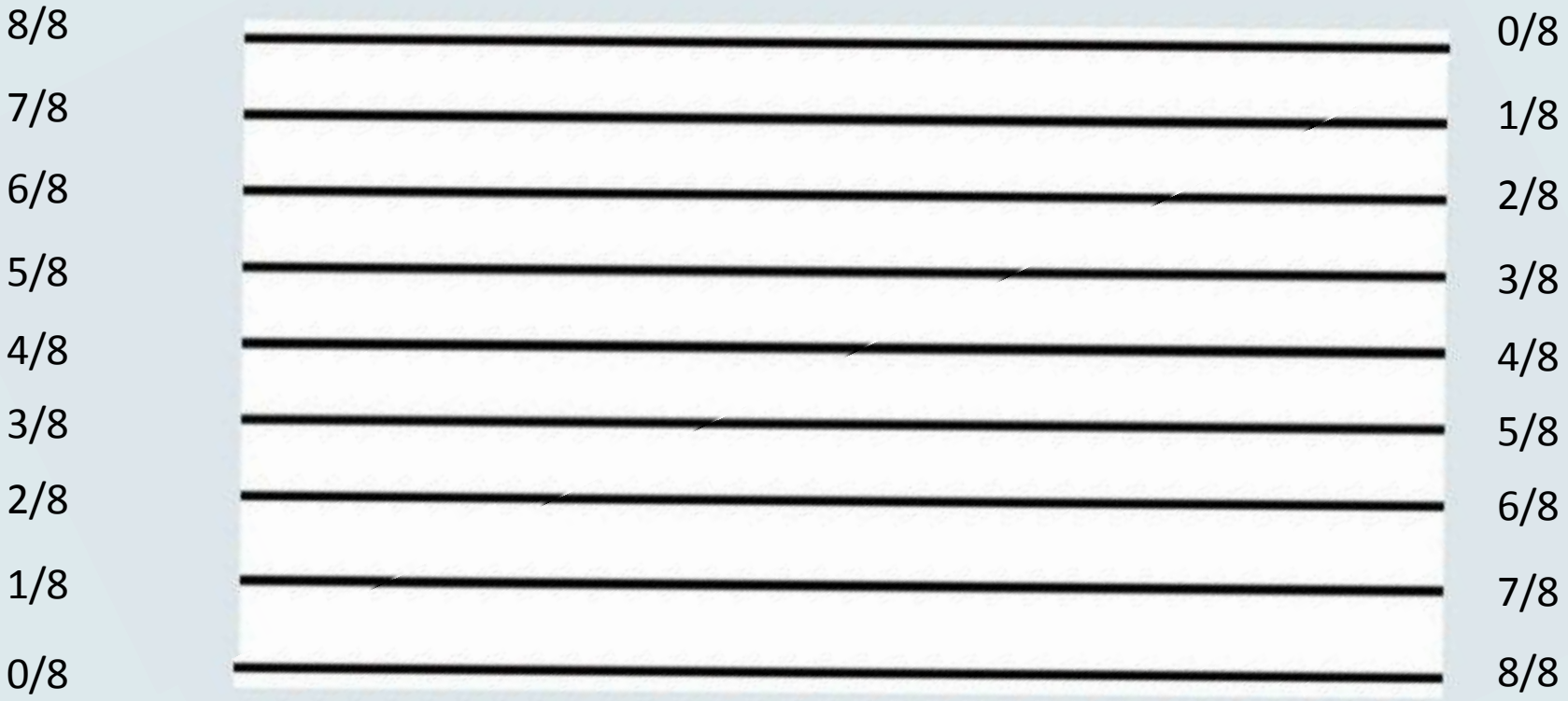

THE VANISHING LEPRECHAUN
©W.A Elliot Co. 1968
Toronto, Canada
WHICH ONE VANISHES? WHERE DOES HE GO? WHEN HE COMES BACK, WHERE HAS HE BEEN? WILL ANYONE EVER SOLVE THIS MYSTERY?


THE VANISHING LEPRECHAUN
WHICH ONE VANISHES? WHERE DOES HE GO? WHEN HE COMES BACK, WHERE HAS HE BEEN? WILL ANYONE EVER SOLVE THIS MYSTERY?

So what's going on? If you want to solve this yourself, I'll understand if you leave the lecture now. But if you want more hints, here's a big one!

You choose where to cut the card

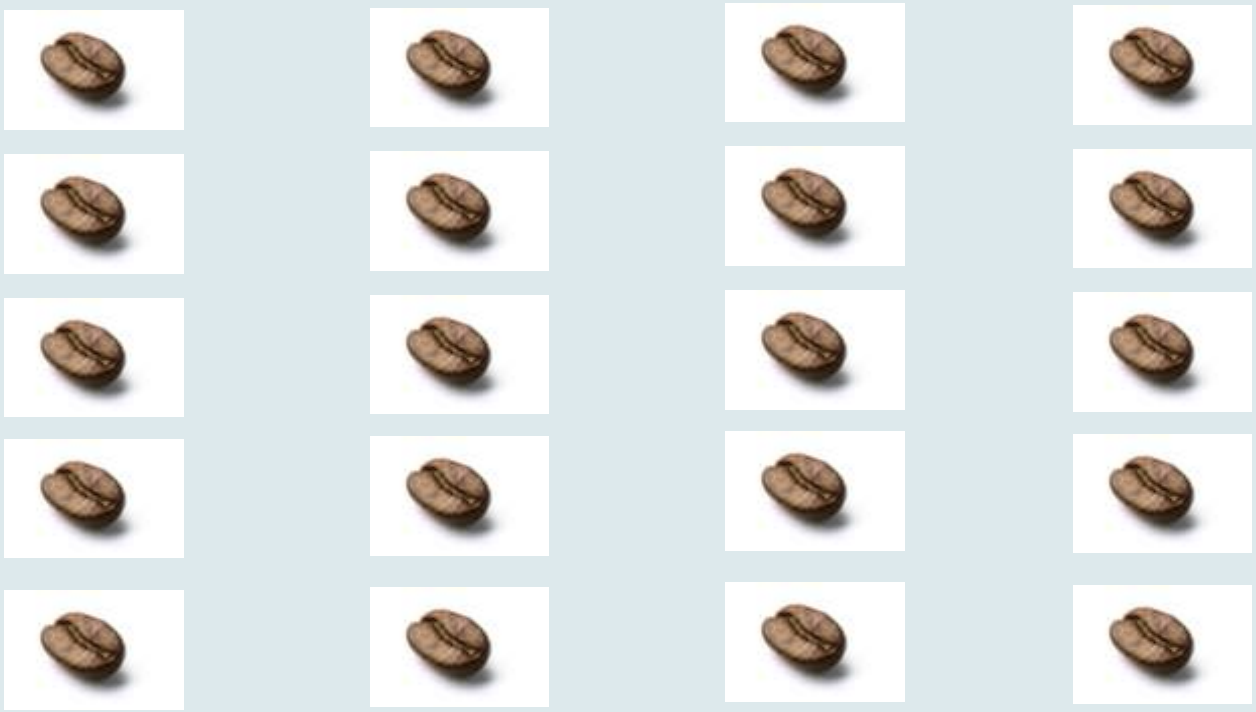
Let’s take away all the fancy stuff and take another look at it in its most basic form.



Here's another way to look at it:

.

Gain a pile: move 4/5, then 3/5, then 2/5, then 1/5.
Then lose a pile: move 1/4 move 2/4, then 3/4, then 4/4.



The next explanation was sent to Brooks/Cole by a student, who sent it to W.A. Elliott (maker of the Leprechaun puzzle), who sent it on to Martin Gardner, who then gave it to Jerry Slocum, who gave it to me. Elliott's cover letter to Gardner mentions, amongst other things, the "tortured" explanation of the Leprechaun puzzle by the teenager from Utah. He adds that he said no to Brooks/Cole's request for permission to use the solution in a brochure because "her teacher might not like all that publicity in view of his foolish suggestion 'not to spend time with it'".

WADDINGTON COMPANY
212 Adelaide Street West, Toronto, Ontario
M5H 1W7

January 10th 1980

Dear Martin,

Here's some more junk for you to move - when you move - if you haven't already moved!

I thought you might like to see our latest version of the Leprechauns, produced in Japan for "First Kitchen". They seem to be some kind of hamburger chain, but I believe they serve "chicken burgers".

The die-cut Santa Puzzle can be punched out of the front of the card to drive everyone mad. This leaves a 4-month winter calendar showing through the window so the idea is to hang up the calendar after you've removed the puzzle.

It's strange (to me anyway) that "First Kitchen" is in English, also the "To" and "From" on the back of the card, but all else is in Japanese. They've done a good job, printing the item in many colors. I have one spare set and would be delighted to send it along if you would like it. If, on the other hand, you prefer Xerox copies for your file, then you've got 'em!

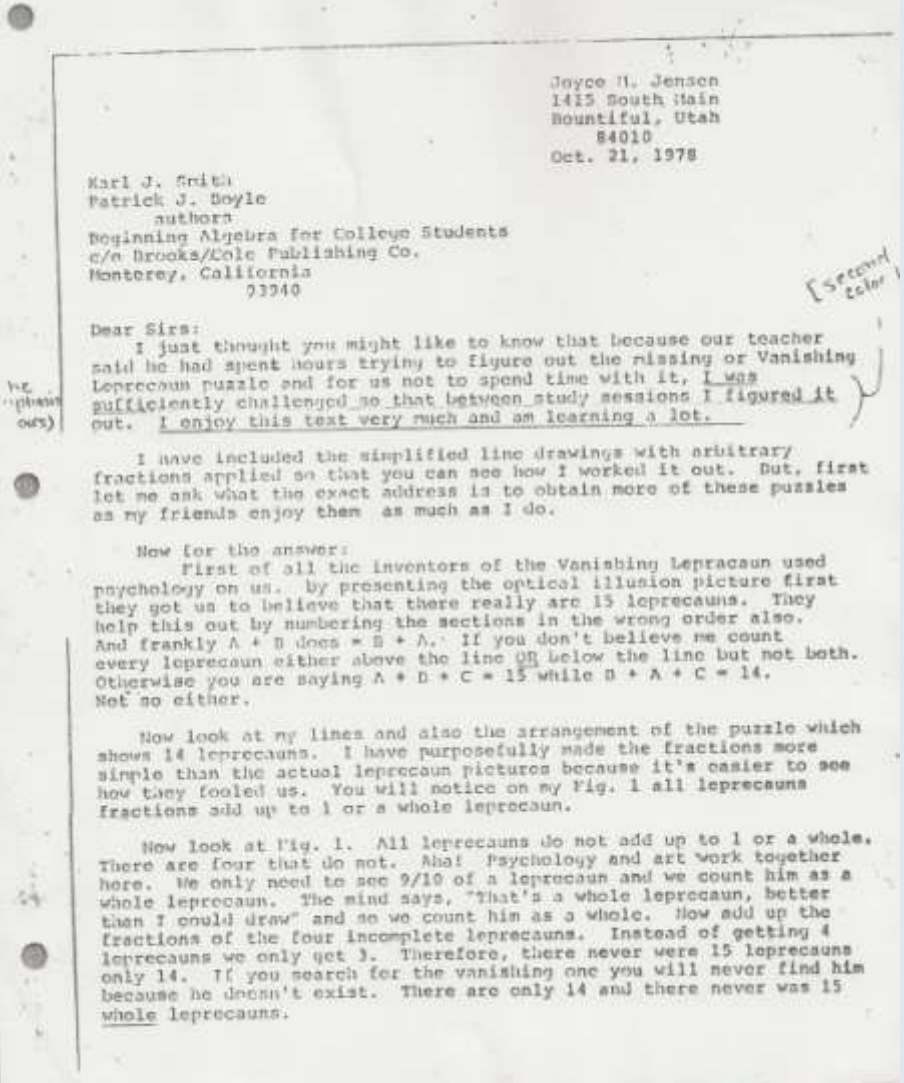
Thought you might also like to glance at the tortured explanation of the Leprechauns submitted to Brooks/Cole Publishing in California by one of their readers. They have published 2 math texts to date, both with our Leprechauns reproduced but no explanation offered.

Brooks/Cole wanted my OK to reproduce Miss Jensen's letter in a brochure to be mailed to teachers. I said I didn't think her teacher might like all that publicity in view of his foolish suggestion "not to spend time with it". The publisher thought it was an excellent example of a puzzle providing a challenge for a student that the student just "had to solve"!

Bob Tappay tells me that you plan moving away from NY to NC or SC or Virginia or somewhere. I can't wish you Happy Moving, because I doubt that moving is ever a happy event. But I do wish you all the best, and am sure you'll enjoy life once you've completed the move and settled in.

Sincerely,

Bill



Joyce H. Jensen
1415 South Main
Bountiful, Utah
84010
Oct. 21, 1978

Karl J. Smith
Patrick J. Doyle
authors
Beginning Algebra for College Students
c/o Brooks/Cole Publishing Co.
Monterey, California
93940

[second color]

Dear Sirs:
I just thought you might like to know that because our teacher said he had spent hours trying to figure out the missing or Vanishing Leprecaun puzzle and for us not to spend time with it, I was sufficiently challenged so that between study sessions I figured it out. I enjoy this text very much and am learning a lot.

I have included the simplified line drawings with arbitrary fractions applied so that you can see how I worked it out. But, first let me ask what the exact address is to obtain more of these puzzles as my friends enjoy them as much as I do.

Now for the answer:
First of all the inventors of the Vanishing Lepracaun used psychology on us. By presenting the optical illusion picture first they got us to believe that there really are 15 leprecauns. They help this out by numbering the sections in the wrong order also. And frankly A + B does = B + A. If you don't believe me count every leprecaun either above the line OR below the line but not both. Otherwise you are saying A + B + C = 15 while B + A + C = 14. Not so either.

Now look at my lines and also the arrangement of the puzzle which shows 14 leprecauns. I have purposefully made the fractions more simple than the actual leprecaun pictures because it's easier to see how they fooled us. You will notice on my Fig. 1 all leprecauns fractions add up to 1 or a whole leprecaun.

Now look at Fig. 1. All leprecauns do not add up to 1 or a whole. There are four that do not. Aha! Psychology and art work together here. We only need to see 9/10 of a leprecaun and we count him as a whole leprecaun. The mind says, "That's a whole leprecaun, better than I could draw" and so we count him as a whole. Now add up the fractions of the four incomplete leprecauns. Instead of getting 4 leprecauns we only get 3. Therefore, there never were 15 leprecauns only 14. If you search for the vanishing one you will never find him because he doesn't exist. There are only 14 and there never was 15 whole leprecauns.

Gee! You've probably already got this figured out. Well it was fun for me anyway. I sure wish figuring out puzzles was worth money. I'm struggling to get my degree. Thanks for such a fine text.

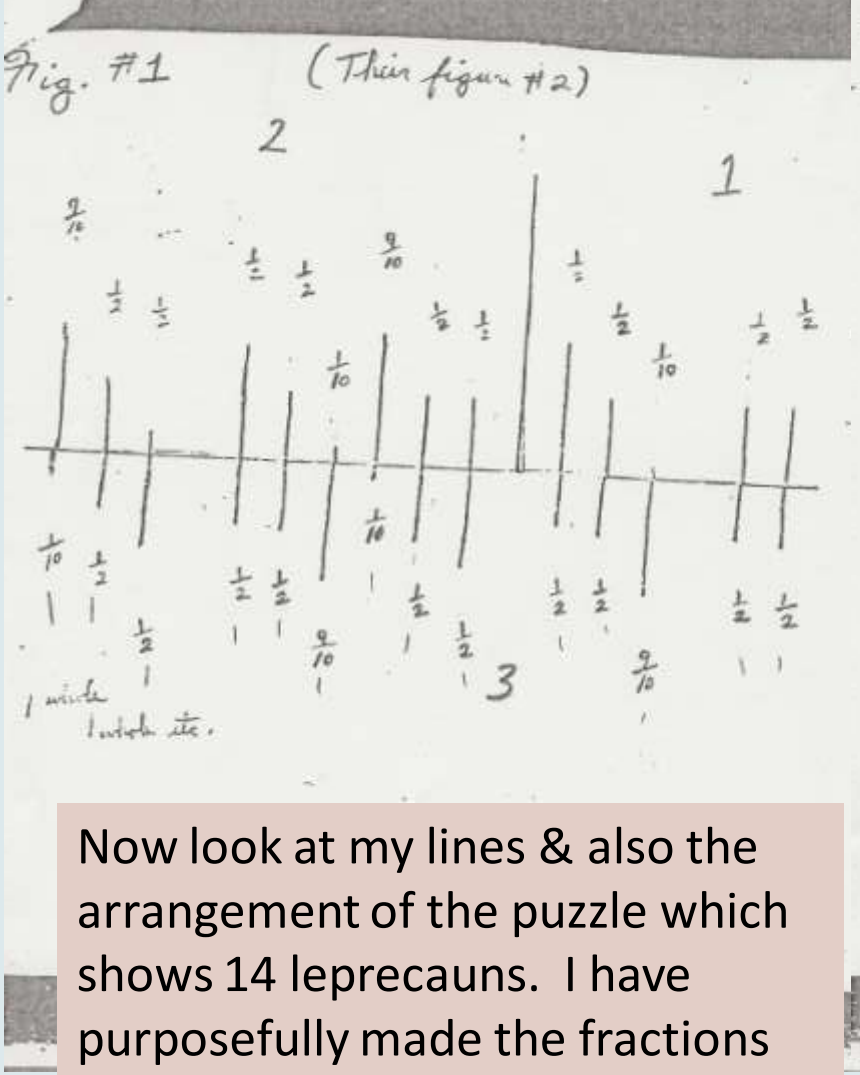
Sincerely,

Joyce Jensen

Dear Sirs:

I just thought you might like to know that because our teacher said he had spent hours trying to figure out the missing or Vanishing Leprecaun (sic) puzzle and for us not to spend time with it, I was sufficiently challenged so that between study sessions I figured it out…I have included the simplified line drawings with arbitrary fractions applied so that you can see how I worked it out…..

Now for the answer: 1st of all the inventors used psychology on us. By presenting the optical illusion picture first, they got us to believe that there really are 15 leprecauns….



Now look at my lines & also the arrangement of the puzzle which shows 14 leprecauns. I have purposefully made the fractions more simple than the actual leprecaun pictures because it's easier to see how they fooled us. Notice all leprecaun fractions add up to 1 whole leprecaun.

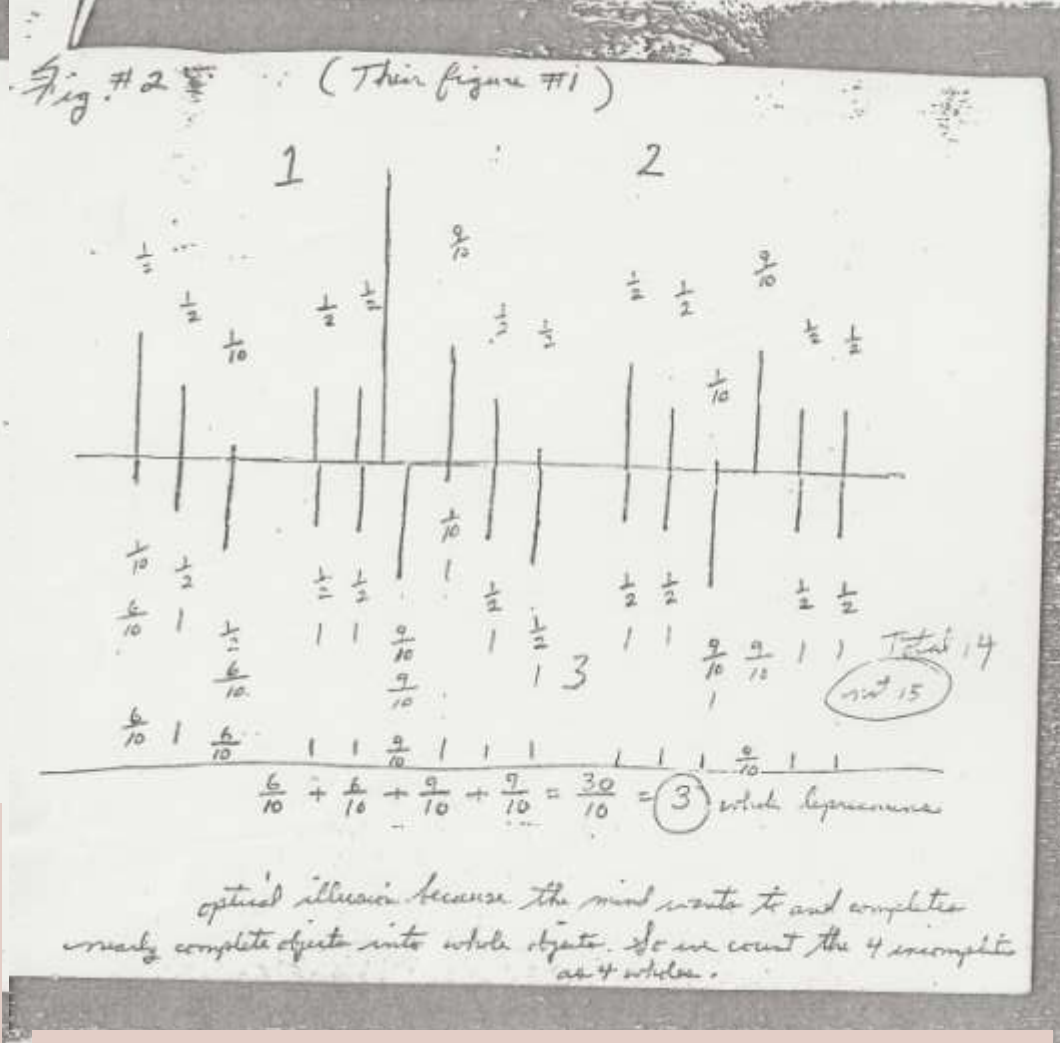


Fig 2 with 15 leprecauns: all leprecauns do not add up to 1. There are four that do not. Aha! Psychology and art work together.We need only 9/10 of a leprecaun and we count him as whole…..

Sincerely, Joyce Jensen

This was one puzzle I knew Jerry didn't have. It was sent to me by a professor who attended an earlier version of this presentation (10 years ago)

which man disappears
SCHWENK@wmich.edu <SCHWENK@wmich.edu>
Thu, Feb 22, 2001 at 5:43 AM
To: sm14@humboldt.edu
Cc: SCHWENK@wmich.edu

Stuart,
I enjoyed your talk yesterday.
Last night I had an amusing thought about which of the six men in tophats disappears. If you print their names between the heads, then we can talk about exactly which guy goes.

```
   J
   O    R    D    R    A
   E    O    O    O    L
---------------------------------------
        Y    N    N    B    L
             A    N    E    E
             L    I    R    N
             D    E    T
```

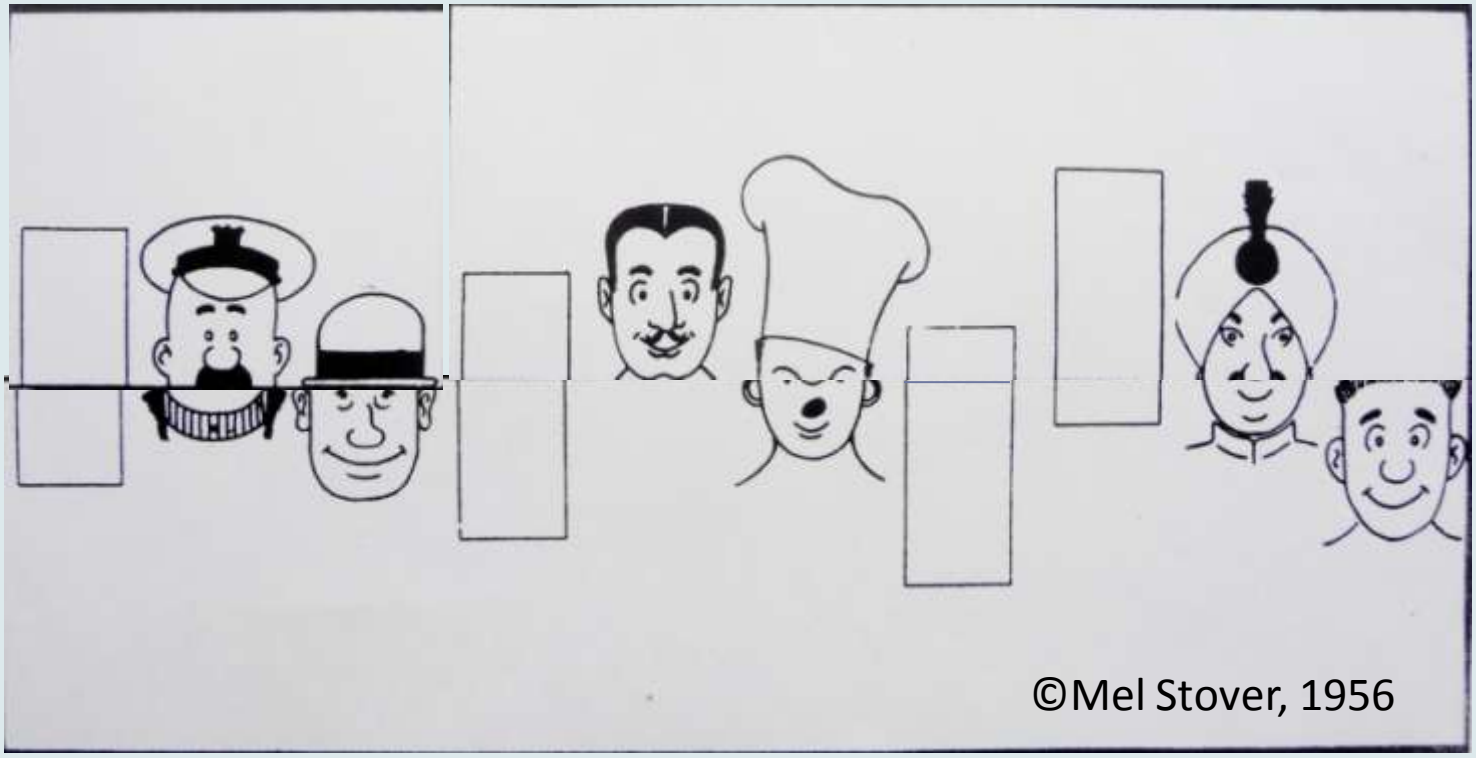
See what happens?
After the shift we have Joey, Ronald, Donnie, Robert, and Allen

Just a thought. Best wishes, Allen Schwenk

LEN
ALBERT
RONNIE
DONALD
ROY
JOE

Just when you might be thinking it’s starting to make sense…..

From Martin Gardner's
MATHEMATICS, MAGIC AND MYSTERY, 1956:



The most famous puzzle of them all is Sam Loyd's "Get Off the Earth", from 1896.

.

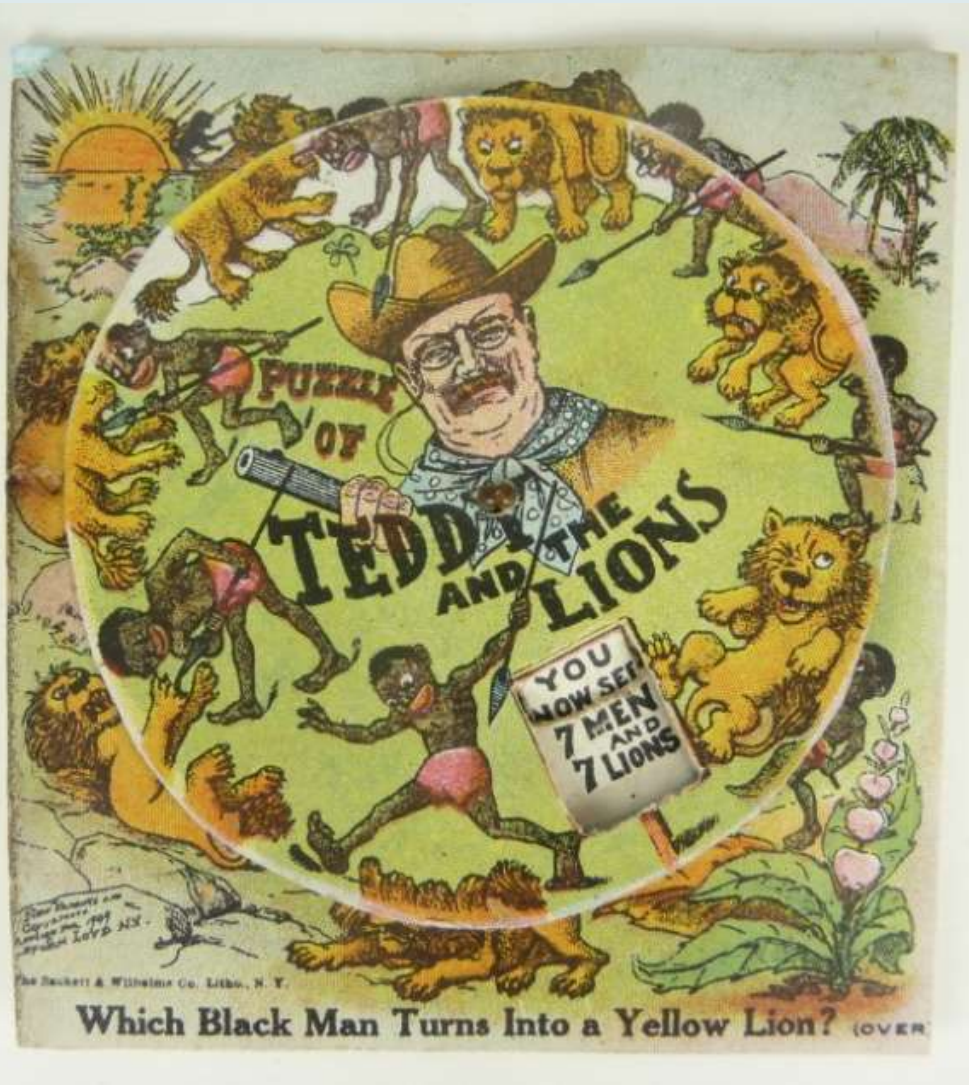
Millions were made.

Used for all kinds of advertising and campaigning (people tend to keep flyers longer if they contain something worth keeping)

Loyd offered all kinds of prizes for the best explanation, including a new bicycle. He received literally 1000s of letters.

Here's a modern version of GOTE:
http://www.samuelloyd.com/gote/index.html

Sam Loyd Originals



In 1896, Republican candidate William McKinley was in trouble. As a means to get people to listen to his message, his campaign contacted Sam Loyd and licensed GOTE. While the back of the puzzle stated McKinley's platform, the bigger message was the disappearing stereotyped Chinese man. American anti-Chinese prejudice was widespread; Denis Kearney's Workingman's Party platform played off fears that Asian immigrants take jobs from Whites. Its slogan bluntly stated "The Chinese Must Go".

With this not-so-subtle message, the Republican Party was subliminally using Kearney's platform. Over 10 million GOTE puzzles are said to have been distributed.

To emphasize this disgraceful bit of history, Chinese were officially banned from Humboldt County from 1885-1959

http://users.humboldt.edu/ogayle/hist383/CentralPacific.html

One more example of how advertisers took advantage of 1890s America and its prejudices:

For the BEST explanation of the principle of the puzzle on the opposite side received within one year from September 1st, 1897, from any policy-holder of the Company whose policy is in force September 1st, 1898, the Company will present a gratuity of **$100 in Gold.** For the **next Best, $95.** For the **third, $90.** For the fourth, $85; and so on to **$5,** making twenty gratuities in all, the **Highest $100,** the **Lowest $5.**

There must appear at the top of the sheet on which the Explanation is made, the number and date of the policy held, together with the address (street, number, city and state) of the competitor, and the name of the agent who last collected on the policy. The explanation is to be sent by mail addressed to the **"Metropolitan Life Insurance Company, New York City, N. Y., Puzzle Department."**

The announcement of the successful competitors will be made in the Company's Paper "The Metropolitan," first issued after the competition closes.

This curious puzzle illustrates the uncertainty of life. We see a little family circle of Japs suddenly broken up, and yet cannot tell beforehand which one is to go. We can only hope that the right one was insured when the miniature earthquake occurred.

The moral is plain. The only way to make sure that the first member of a family who dies is insured, is for every member of the family to have a policy.

Every one of those policies will be realized on if they are kept in force, for, though we may go through life without sickness or accident, none can evade death. From that there is no escape and no postponement.

Life policies, payable at the death of the insured, and Endowment policies payable to the insured during his lifetime, are issued by the

Metropolitan Life Insurance Co.

on both sexes and at all ages, between two and seventy. Premiums run from five cents per week, upward, and are collected from the home of the insured by the Company's agents. Claims are paid immediately upon receipt and approval of proofs of death. The Company is now paying one every seven minutes of each business day, and is disbursing $16 a minute in doing so! It has already distributed among its policy-holders a sum which, including that now invested for their security, exceeds Eighty-five millions of dollars. Its assets amount to Thirty-four millions, and its surplus to considerably more than five millions. It has close to four millions of policies in force, and yet there is room for you, reader, if you are not insured, or if you want to increase your present insurance.

The Company has also an Intermediate Branch, in which policies for even-$500 are issued, on males or females from 12 to 65; premiums payable quarterly, half-yearly or annually.

It has also an Ordinary Department, in which policies from one to twenty-five thousand dollars are issued on adult lives.

For full particulars send to the home office, or to any of the branch offices.

BRANCH OFFICE,

Not all advertisers exploited racism and politics.

DR. MILES'

New System of Restorative Remedies.

Restorative Nervine is a brain and nerve food, and medicine; that soothes while it nourishes and strengthens the whole system.

New Heart Cure is the only reliable remedy known for heart disease. A tonic that strengthens the heart and makes new, pure blood.

Restorative Tonic is a scientific combination of iron, phosphates and other remedial agents. Both a food and a medicine.

Restorative Blood Purifier for removing impurities from the brain, nerves, bones, skin and mucous membranes.

Nerve and Liver Pills, For Constipation, Biliousness, etc.

Nerve Plasters For Backache, Irritability, Etc.

Pain Pills For Headache and other pain.

Dr. Miles' Remedies

Are sold strictly on their merits. To parties who have not tried them, the druggist will sell first bottle on guarantee that it will benefit or money will be refunded.

Dr. Miles' Remedies

Are thoroughly scientific in their preparation, represent the latest discoveries in medicines, and are used constantly by Dr. Miles in his extensive private practice.

Dr. Miles' Remedies

Are as represented. They restore the invalid to health. They cure. This is why we can make this broad guarantee. For full description of Dr. Miles' Restorative Remedies ask for Dr. Miles' book, "New and Startling Facts." Sent free on request.

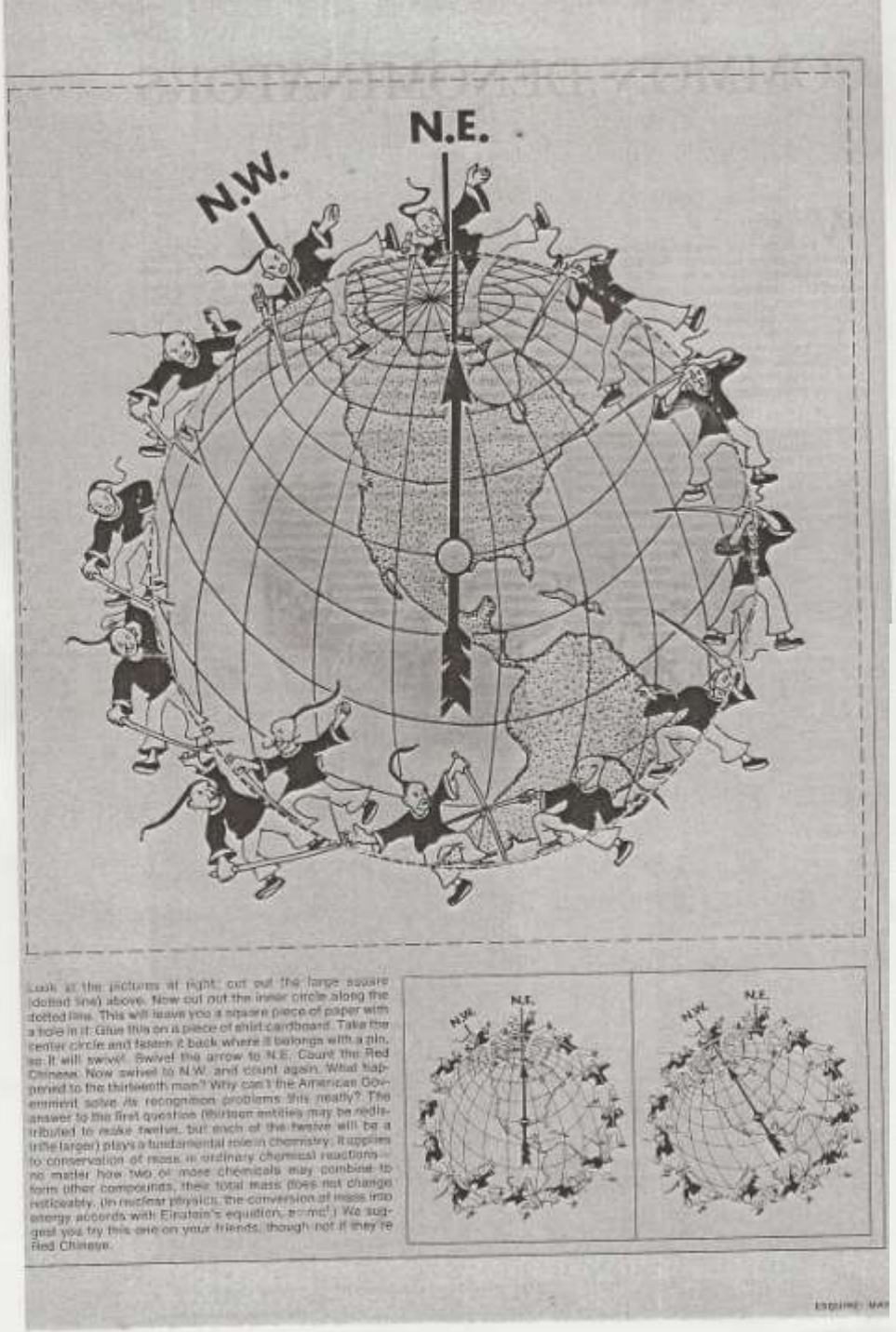
DR. MILES MEDICAL CO., ELKHART, IND.

WHEN THE BUTTON IS **DOWN,** THERE ARE THIRTEEN CHINAMEN; MOVE THE BUTTON **UP,** AND THERE ARE ONLY TWELVE. **WHERE DOES HE GO?** (A little four-year-old in INDIANAPOLIS, Said: "Dess he didn't take Docker Miles' Nervine.")

Some versions didn’t sell anything (I think)

GOTE continues to be used for political messages.

From Esquire Magazine, 1955?



Look at the pictures at right; cut out the large square (dotted line) above. Now cut out the inner circle along the dotted line. This will leave you a square piece of paper with a hole in it. Glue this on a piece of shirt cardboard. Take the center circle and fasten it back where it belongs with a pin, so it will swivel. Swivel the arrow to N.E. Count the Red Chinese. Now swivel to N.W. and count again. What happened to the thirteenth man? Why can't the American Government solve *its* recognition problems this neatly? The answer to the first question (thirteen entities may be redistributed to make twelve, but each of the twelve will be a trifle larger) plays a fundamental role in chemistry; it applies to conservation of mass in ordinary chemical reactions—no matter how two or more chemicals may combine to form other compounds, their total mass does not change noticeably. (In nuclear physics, the conversion of mass into energy accords with Einstein's equation, $e=mc^2$.) We suggest you try this one on your friends, though not if they're Red Chinese.

If these puzzles provide insights into the important issues of the time, then what does this one by Robin DeBreuil and titled “Who Turned to Doggie Doo?” say about our current era?

http://debreuil.com/ddw/puzjava/picmove.htm

12 years ago, in the spirit of Sam Loyd, Robin DeBreuil was offering anybody who could explain Who Turned to Doggie Doo a "FREE copy of this puzzle, beautifully printed, and mounted on foam board (or not foam board...)“.

So I wrote to him with with my explanation. He wrote back and pleaded poverty, but he did add that “Martin Gardner... I bet he could figure out these things while waiting for his toast to pop.”

To Protect his rights, Loyd Patented His Invention

UNITED STATES PATENT OFFICE.

SAMUEL LOYD, OF NEW YORK, N. Y.

TRANSFORMATION PICTURE.

SPECIFICATION forming part of Letters Patent No. 563,778, dated July 14, 1896.

Application filed March 11, 1896. Serial No. 582,802. (No model.)

To all whom it may concern:

Be it known that I, SAMUEL LOYD, a citizen of the United States of America, and a resident of the city, county, and State of New York, have invented a new and useful Improvement in Transformation Pictures, of which the following is a specification, reference being made to the accompanying drawings.

The object of my invention is to produce a transformation puzzle picture, so constructed that figures or parts of the picture may be made to appear or vanish at will by a slight movement of a revolving portion of the picture.

In the accompanying drawings, Figure 1 shows the picture containing eight squares and figures of men. Fig. 2 shows the same picture with the central disk slightly turned, so that the dissected figures again match, but present the appearance of but seven squares and men.

The disk revolves upon the pivotal point Y and is restricted by the groove and pin I from making more than a one-eighth turn, so that at either end of the movement all of the figures will match properly.

In Fig. 1 there are eight squares and eight men. By giving the disk an eighth-turn *h* will match with G, *g* will match F, *f* will match E, *e* will match D, *d* will match C, *c* will match B, and *b* will match A; but as nothing goes from A to H, the picture will, as shown in Fig. 1, present but seven squares and seven men. Each square and man has absorbed a small portion of the missing one, which is so evenly distributed as to be almost imperceptible and gives the appearance of one figure having vanished. A reverse movement of the disk will cause an eighth man to evolve from the seven.

The figures, it will be seen, are drawn in sections of a circle, equidistant apart, on the periphery, but at different distances from the center of the disk, increasing in regular progression, according to the line of a volute, as shown.

By the introduction of a second series of figures, drawn upon the line of a reversed volute, the two principles may be introduced in the one picture, so that when the figure of one series vanishes the other will appear.

I claim as my invention—

A transformation picture divided into two or more parts, arranged upon movable pieces, each of which contains parts of a sequence of figures or subjects placed at equidistant points, so that a slight turn of the movable part leads to a new point of contact, matching the dividing parts and producing variable results, substantially as shown.

In testimony that I claim the foregoing as my invention I have signed my name, in presence of two witnesses, this 10th day of March, 1896.

SAMUEL LOYD.

Witnesses:
A. WILFORD HALL,
GEO. B. KERR.

(No Model.)

S. LOYD.
TRANSFORMATION PICTURE.

No. 563,778. Patented July 14, 1896.

Fig 1

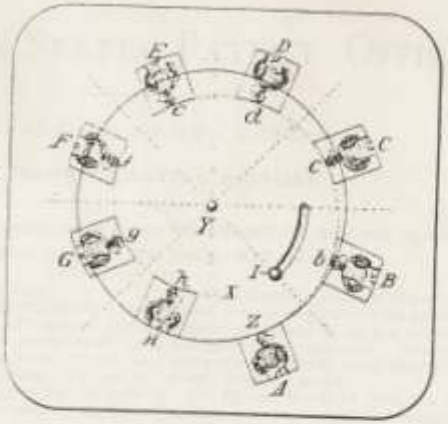
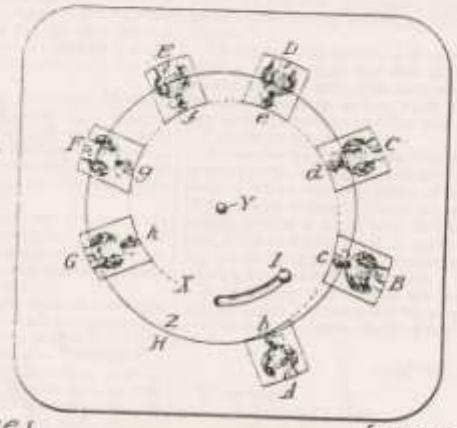


Fig 2



Witnesses.
A. Wilford Hall
R. D. Wyckoff.

Inventor.
Samuel Loyd

But it didn't stop the countless bootleggers. Many unauthorized versions were produced.

Here's a German one:

Here's one from Canada:

A Medicine Chest in Itself.

A BOTTLE OF

TRAPPER'S OIL

Should be at hand in every family, for instant use in cases of emergency.

IT CURES PAIN

In all its forms.

A GUARDIAN ANGEL.

A Family Physician in Town and Country, saving hundreds of dollars in doctors' bills, is

TRAPPER'S OIL,

THE GREATEST

PAIN ERADICATOR

KNOWN.

Only one size, 50 Cents per Flask.

26561

TRAPPER'S OIL,

THE GREAT PAIN ERADICATOR.

EXTERNALLY.—Rub in for Rheumatism, Neuralgia, Lame Back, Pain in the Chest, Sore Throat, Diphtheria, Spinal Complaints, Stiff Joints, etc.

SOLD EVERYWHERE.

FIFTY CENTS PER FLASK.

TRAPPER'S OIL.

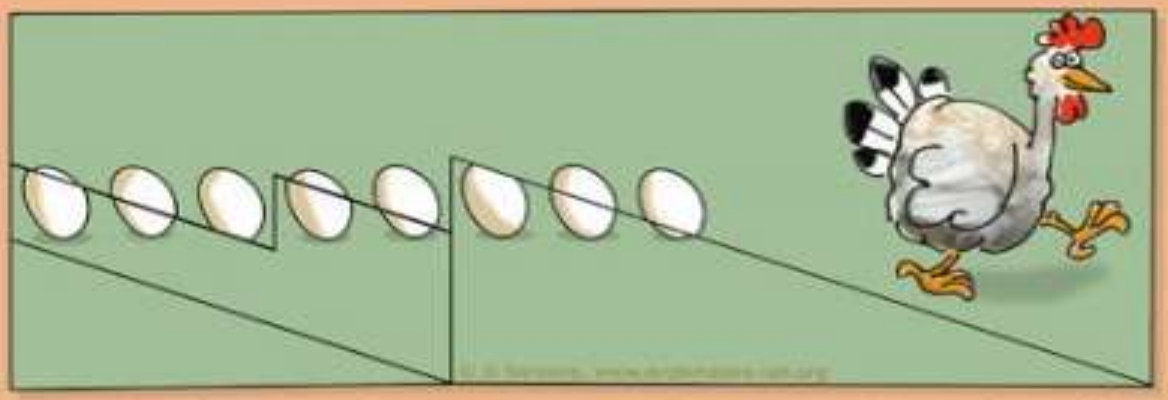
INTERNALLY.—In teaspoon doses, cures Cramp Colic, Diarrhœa, Painters' Colic, Sea Sickness, Bowel Complaints, and Nervous Tremor that follows Drunkenness and Fatigue.

SOLD BY DRUGGISTS,

AT FIFTY CENTS PER FLASK.

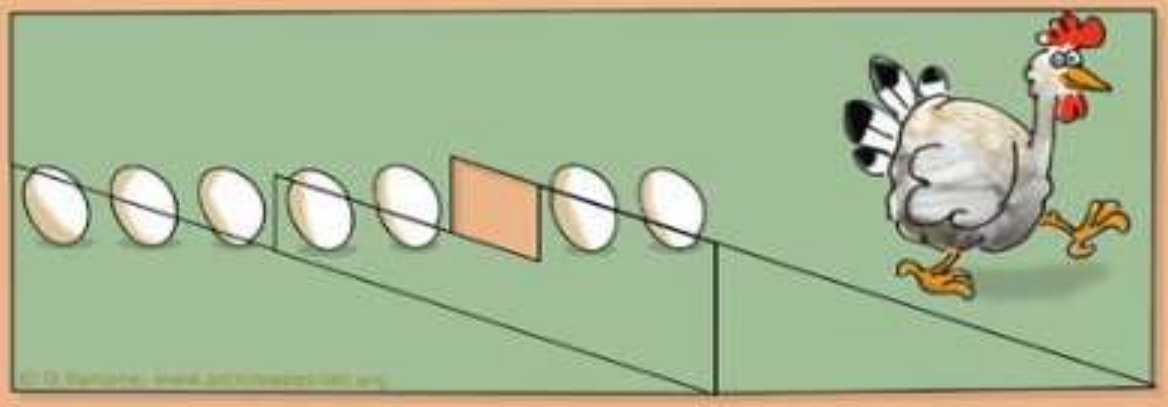
5-00908

A

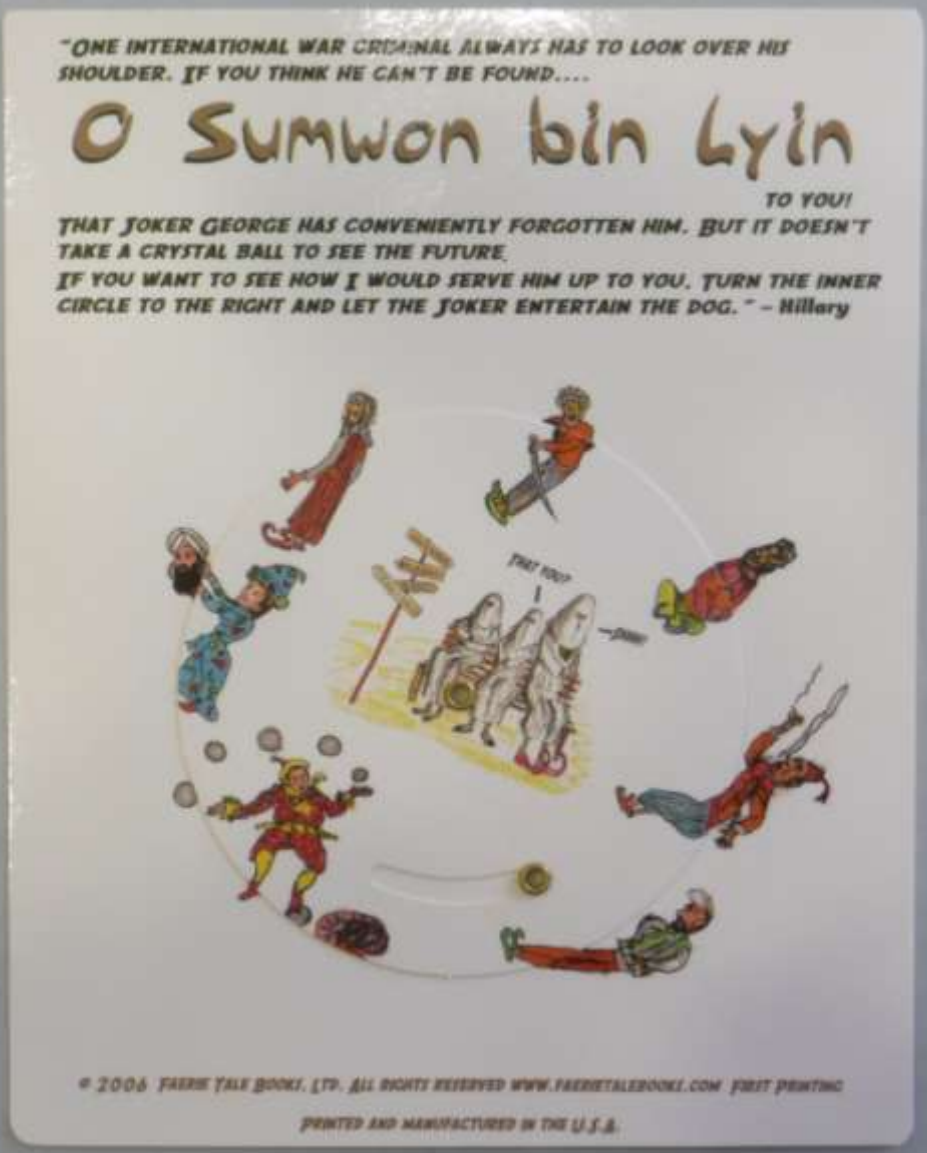


By permuting the triangular pieces an egg disappears. How does it happen?

B



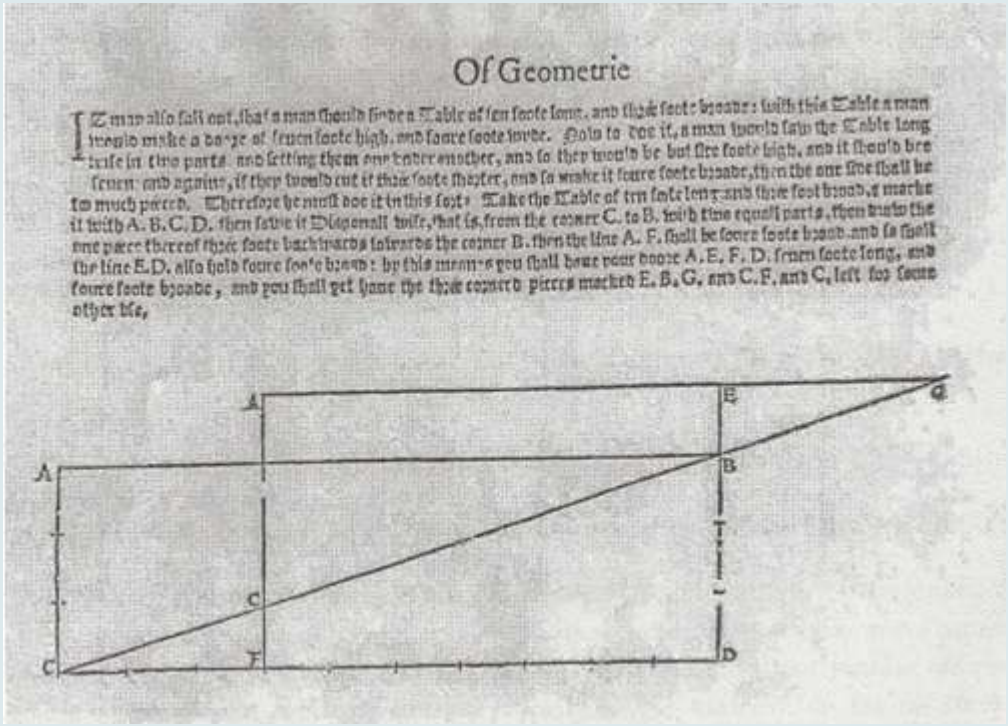
Political Themes are still popular:



The puzzles so far have all been essentially one-dimensional, that is, objects get shorter or longer. Now, let's move to two dimensions and explore puzzles where area appears either to vanish or appear from nowhere.

Sebastiano Serlio's Architettura, 1545

"a man should finde a Table of ten foote long, and three foote broade: with this Table a man would make a doore of seven foote high, and foure foote wide…and you shall yet have (two) three cornerd pieces" (with a combined area of 3 square feet)



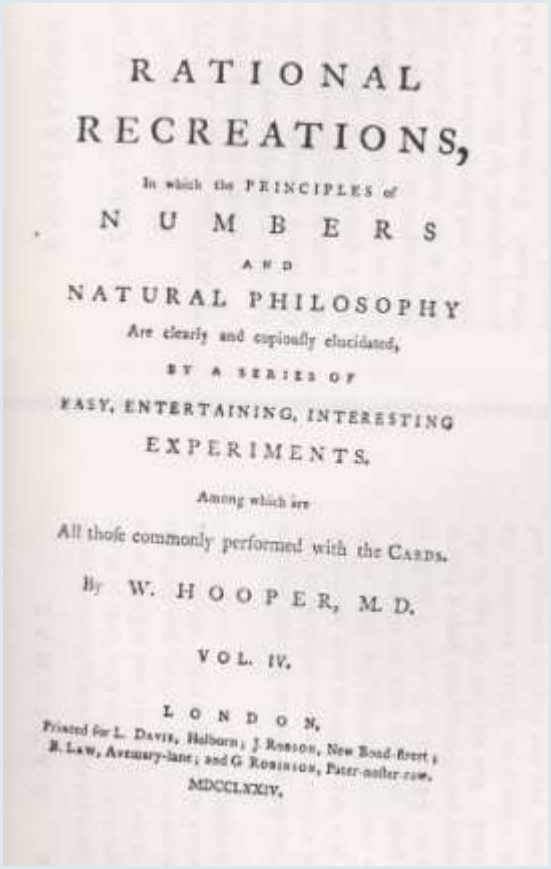
Of Geometrie

A man also saith, that a man should finde a Table of ten foote long, and three foote broade: with this Table a man would make a doore of seven foote high, and foure foote wide. How to doe it, a man would saw the Table long wise in two parts, and setting them one before another, and so they would be but five foote high, and it should bee seuen and againe, if they would cut it three foote thicker, and so make it foure foote broade, then the one side shall be too much pieced. Therefore he saith doe it in this sort: Take the Table of ten foote long and three foot broad, & marke it with A. B. C. D. then saw it Diagonall wise, that is, from the corner C. to B. with tine equall parts, then draw the one peece thereof three foote backwards towards the corner B. then the line A. F. shall be foure foote broad, and so shall the line E. D. also hold foure foote broad: by this meanes you shall have your doore A. E. F. D. seuen foote long, and foure foote broade, and you shall yet have the three cornerd pieces marked E. B. G. and C. F. and C. left for some other vse.

William Hooper, Rational Recreations

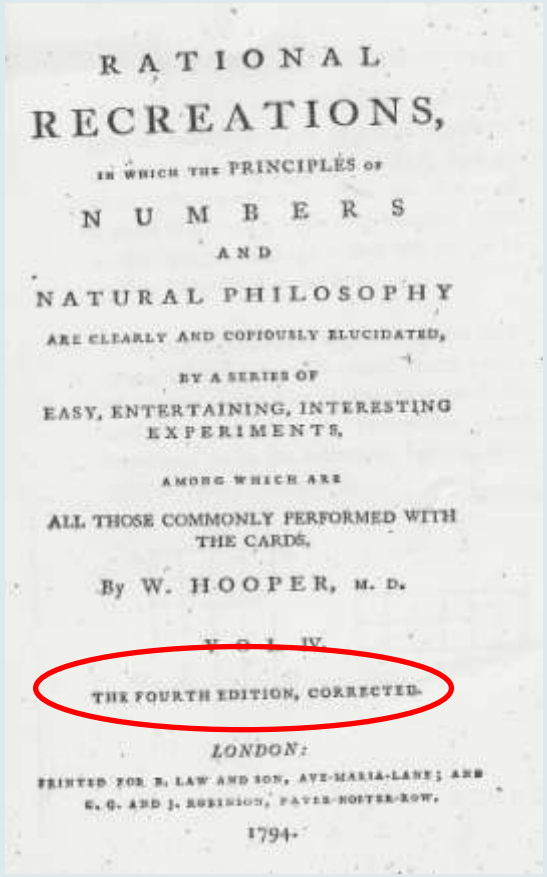
1st ed. 1774, 4th ed. 1794

Did Hooper understand the paradox or was he just plagiarizing Edme Guyot's Nouvelles Recreations Physiques et Mathematiques, which had a major error in the 1st edition in 1770 and was corrected in the 2nd ed. 1775



RATIONAL
RECREATIONS,
In which the PRINCIPLES of
NUMBERS
AND
NATURAL PHILOSOPHY
Are clearly and copiously elucidated,
BY A SERIES OF
EASY, ENTERTAINING, INTERESTING
EXPERIMENTS.
Among which are
All those commonly performed with the CARDS.
By W. HOOPER, M. D.
VOL. IV.
LONDON,
Printed for L. DAVIS, Holborn; J. ROBSON, New Bond-Street;
B. LAW, Ave-mary-lane; and G. ROBINSON, Pater-noster-row.
MDCCLXXIV.

1st edition, MDCCLXXIV



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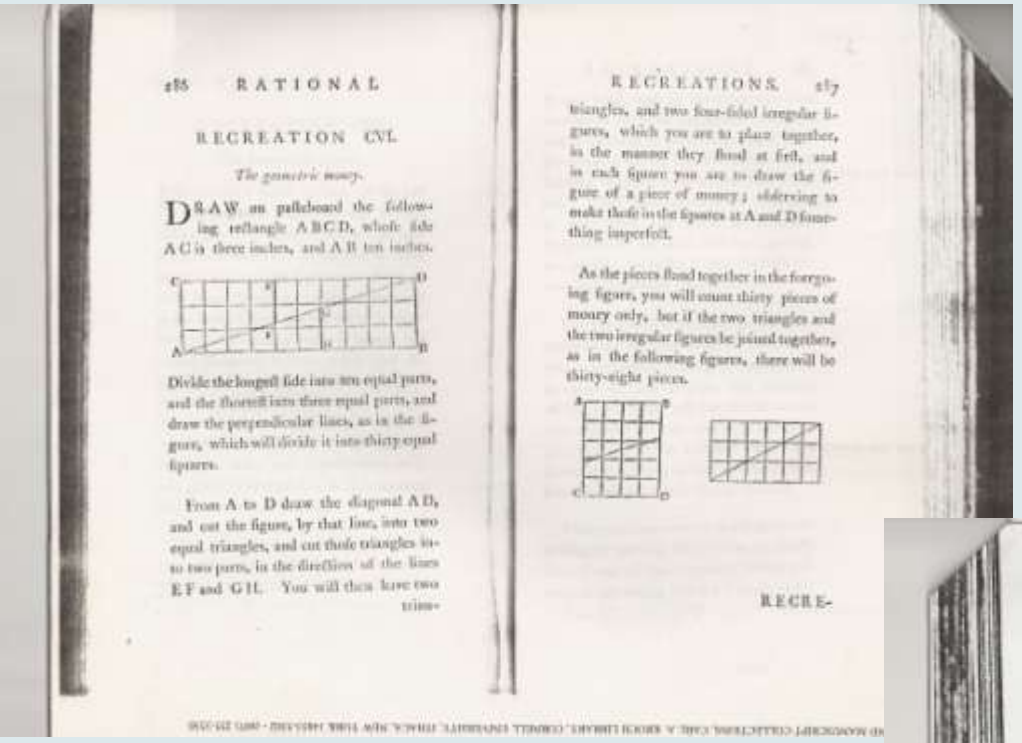
4th edition, corrected, 1794

Hooper's Geometric Money



286 RATIONAL

RECREATION CVI.

The geometric money.

DRAW on pafteboard the following rectangle ABCD, whofe fide AC is three inches, and AB ten inches.

Divide the longeft fide into ten equal parts, and the fhorteft into three equal parts, and draw the perpendicular lines, as in the figure, which will divide it into thirty equal fquares.

From A to D draw the diagonal AD, and cut the figure, by that line, into two equal triangles, and cut thofe triangles into two parts, in the direction of the lines EF and GH. You will then have two trian-

RECREATIONS. 287

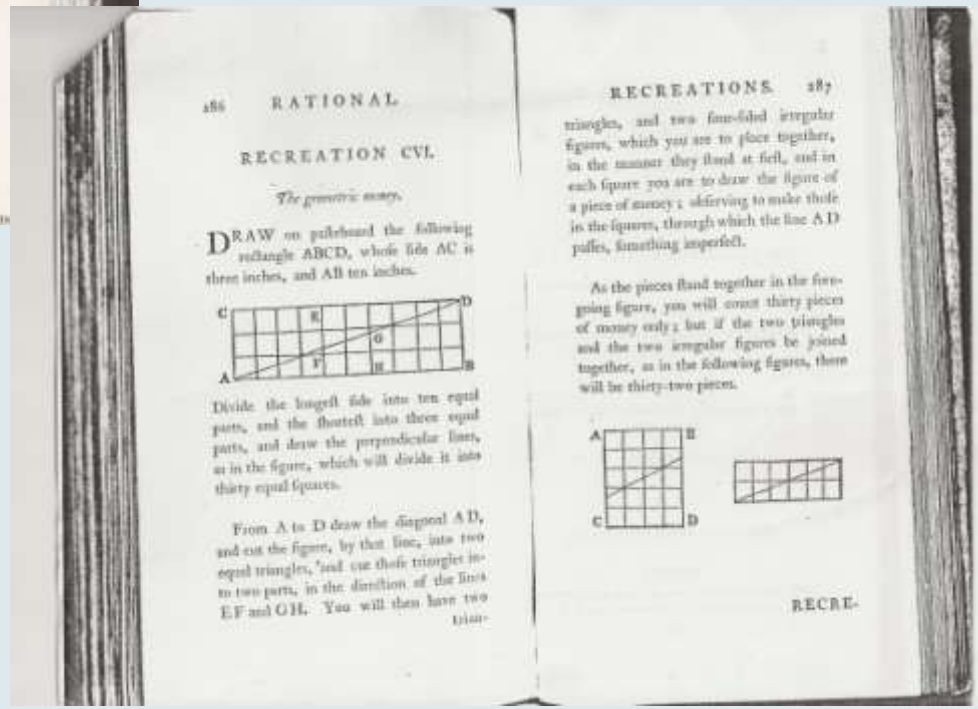
triangles, and two four-fided irregular figures, which you are to place together, in the manner they ſtood at firſt, and in each figure you are to draw the figure of a piece of money; obſerving to make thoſe in the figures at A and D ſomething imperfect.

As the pieces ſtood together in the foregoing figure, you will count thirty pieces of money only, but if the two triangles and the two irregular figures be joined together, as in the following figures, there will be thirty-eight pieces.

RECRE-

4th ed: 3 x 10 = 5 x 4 + 2 x 6
30 = 32

1st ed: 3 x 10 = 5 x 4 + 3 x 6
30 = 38



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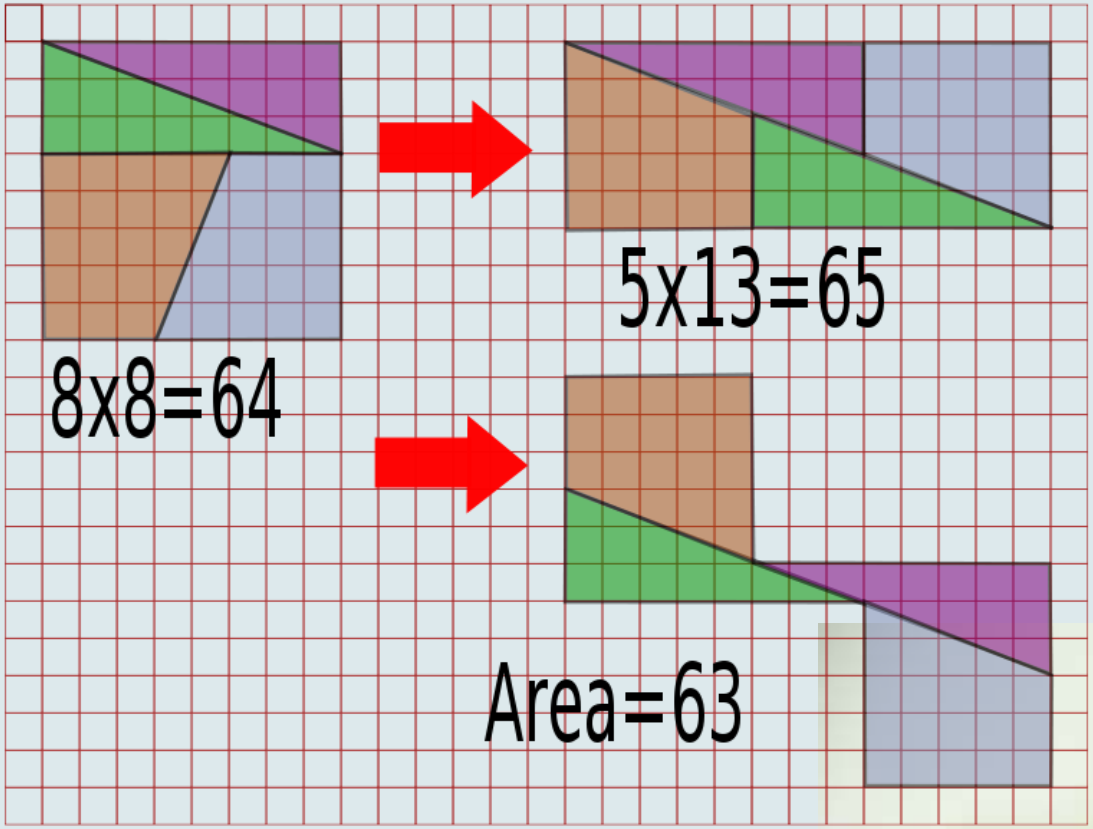
RECREATIONS. 287

triangles, and two four-fided irregular figures, which you are to place together, in the manner they ſtood at firſt, and in each figure you are to draw the figure of a piece of money; obſerving to make thoſe in the figures, through which the line AD paſſes, ſomething imperfect.

As the pieces ſtood together in the foregoing figure, you will count thirty pieces of money only; but if the two triangles and the two irregular figures be joined together, as in the following figures, there will be thirty-two pieces.

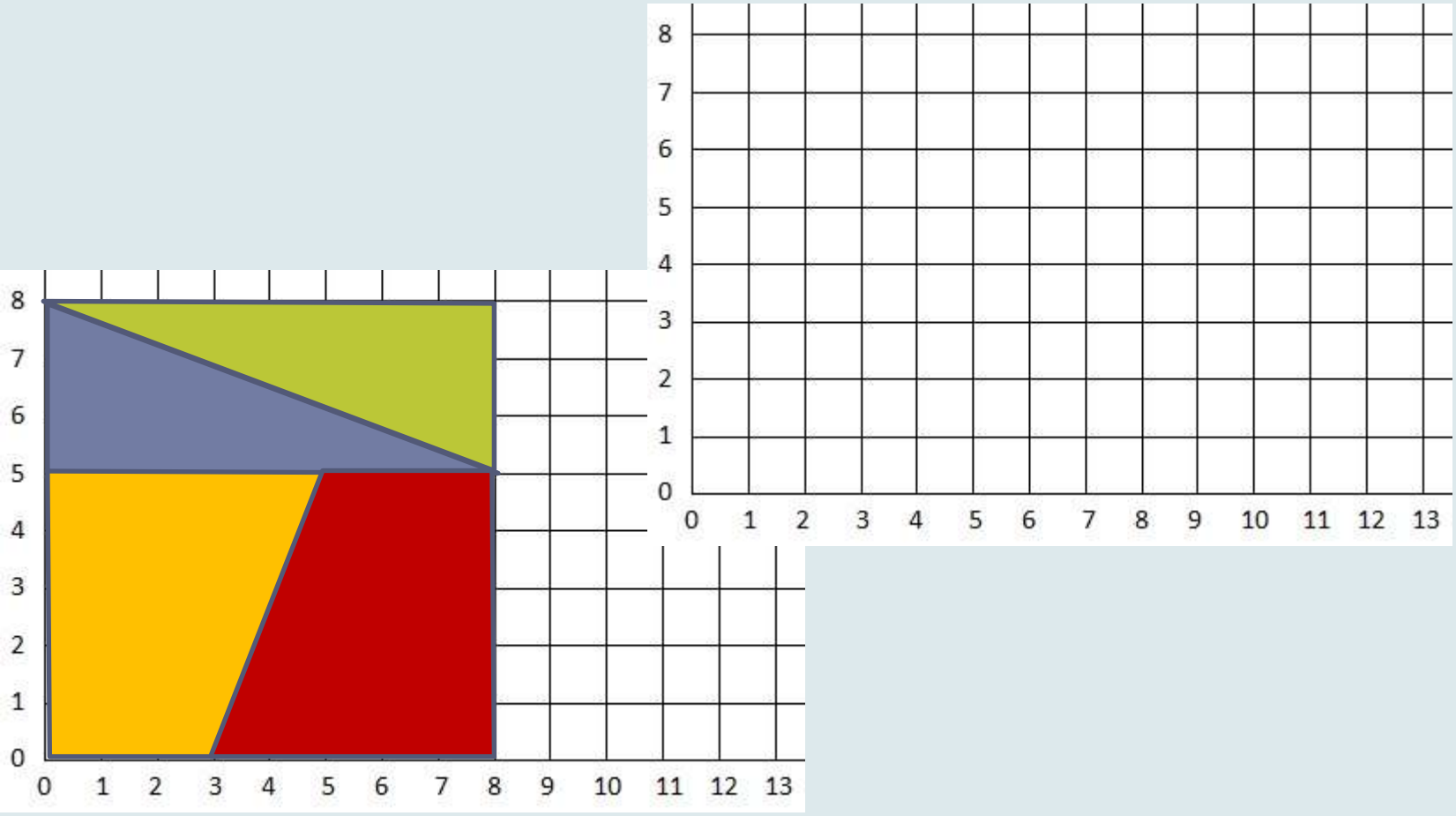
RECRE-



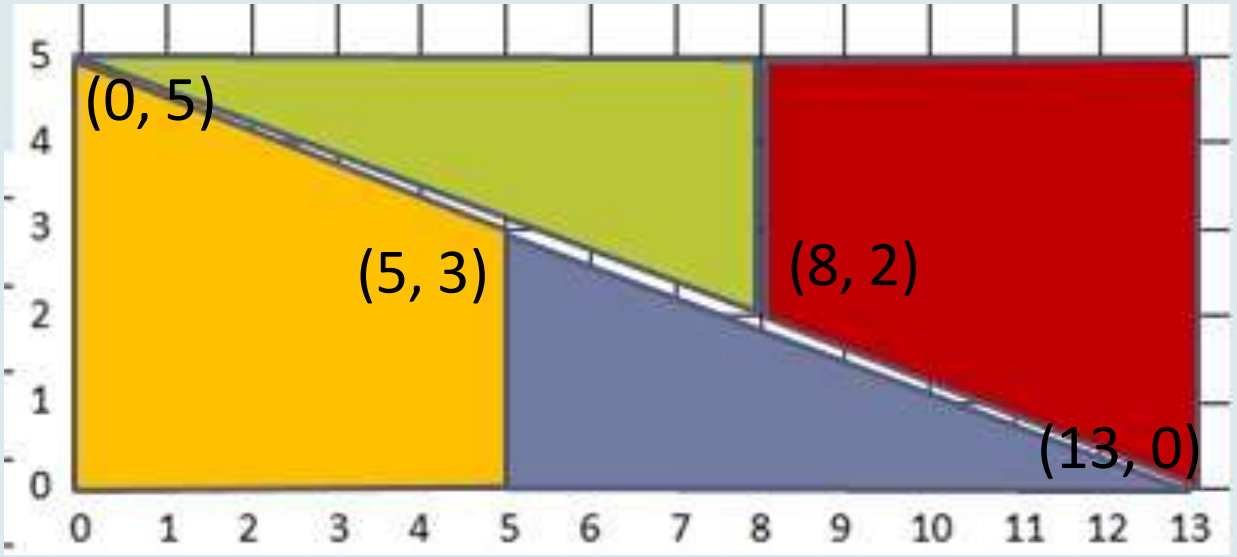
63 = 64 = 65

A French version from the 1800s

What happens when we move the pieces very carefully?



Add coordinates to the diagram:



Calculate the slopes of the 4 segments:

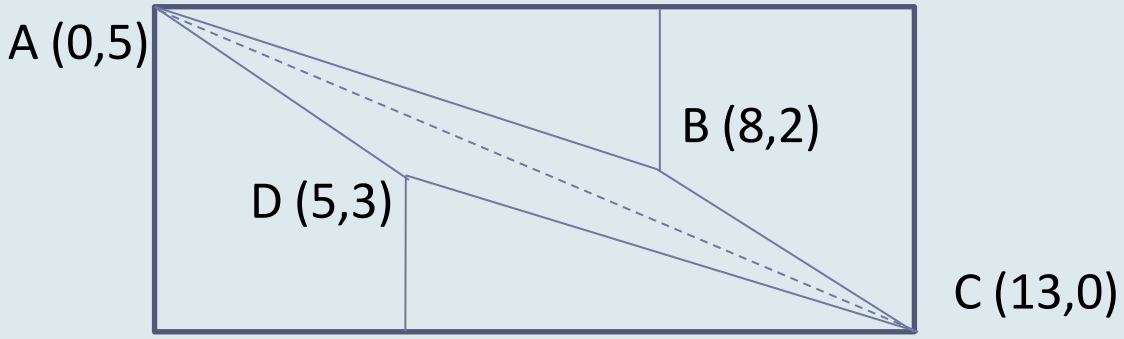
$$m_1 = \frac{5-3}{0-5} = -\frac{2}{5} \qquad m_2 = \frac{5-2}{0-8} = -\frac{3}{8}$$

$$m_3 = \frac{2-0}{8-13} = -\frac{2}{5} \qquad m_4 = \frac{3-0}{5-13} = -\frac{3}{8}$$

What first appeared to be a diagonal of the rectangle is actually a parallelogram shaped hole!!

What's the area of this parallelogram?

To better see what's happening here, let's redraw the rectangle (not to scale) and divide the parallelogram into 2 congruent triangles:



$$m(\overline{AB}) = \sqrt{(0-8)^2 + (5-2)^2} = \sqrt{73} \quad \text{=side } a$$

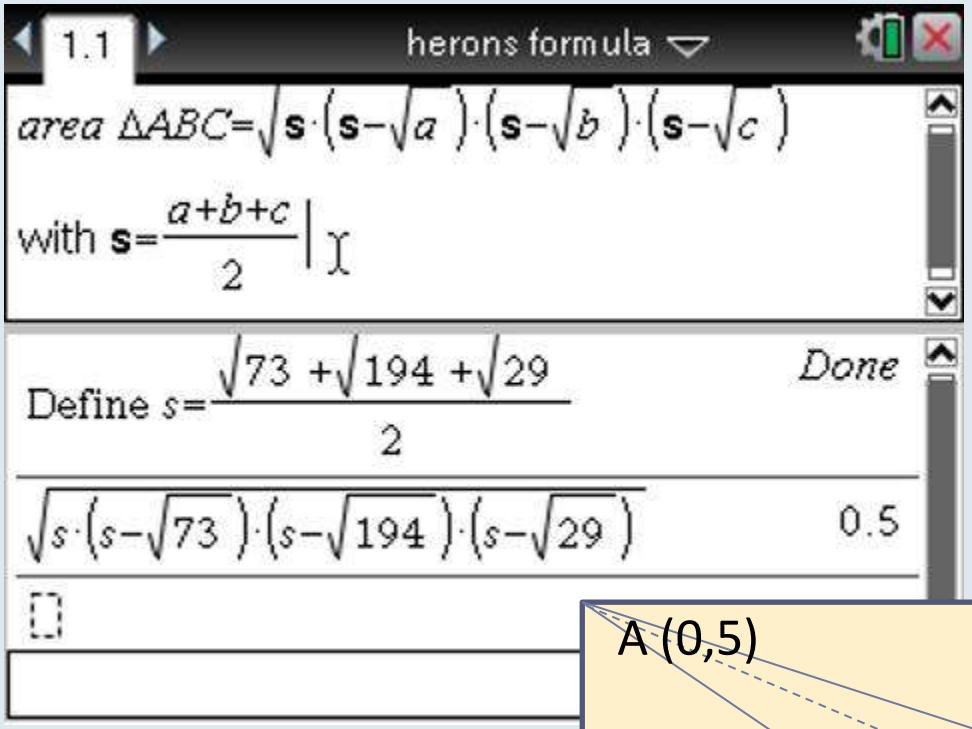
Using the distance formula: $m(\overline{AC}) = \sqrt{(0-13)^2 + (5-0)^2} = \sqrt{194}$ =side b

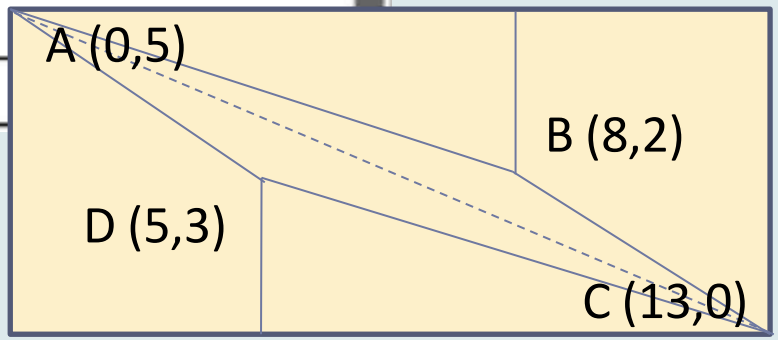
$$m(\overline{BC}) = \sqrt{(8-13)^2 + (2-0)^2} = \sqrt{29} \quad \text{=side } c$$

Next use Heron's Formula: Area $\Delta ABC = \sqrt{s(s-a)(s-b)(s-c)}$

with $s = \dfrac{a+b+c}{2}$

Using TI-Nspire:



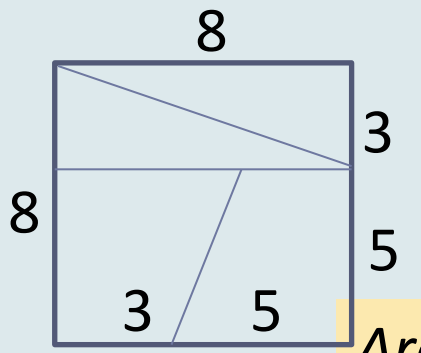


Since $\Delta ABC \cong \Delta CDA$

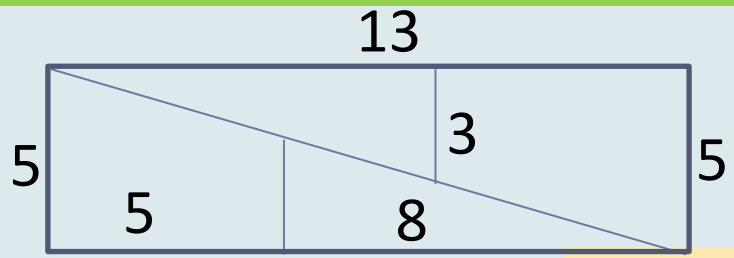
Area parallelogram ABCD = .5 +.5 = 1

Therefore we have found the extra unit of area!!

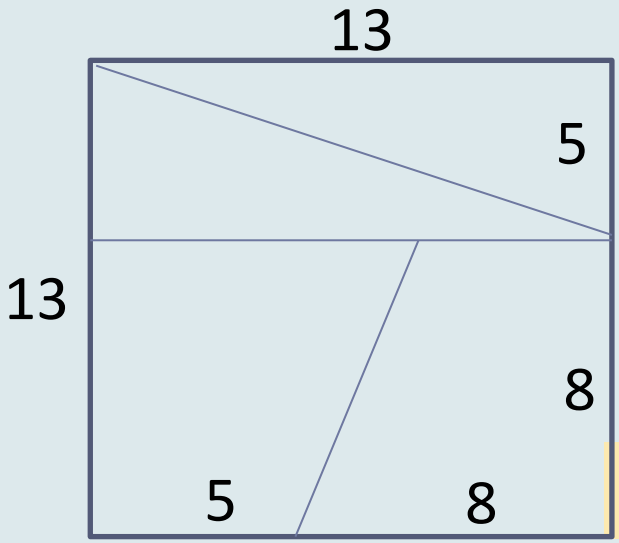
Let's explore other cut-up squares that have been changed to rectangles:



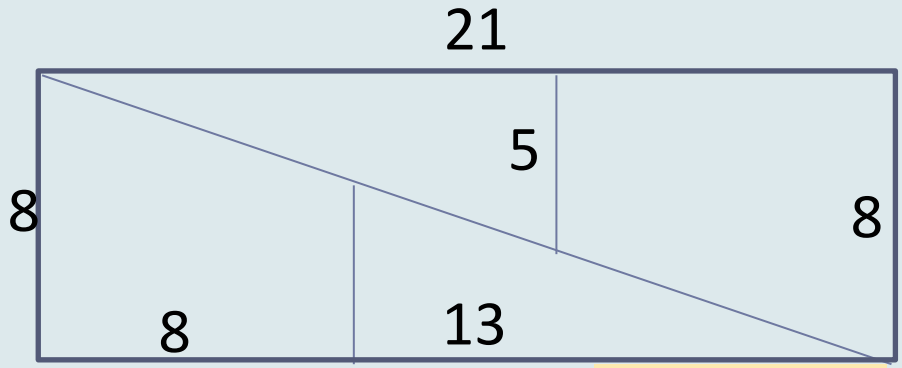
Area=64



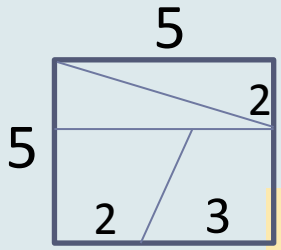
Area=65



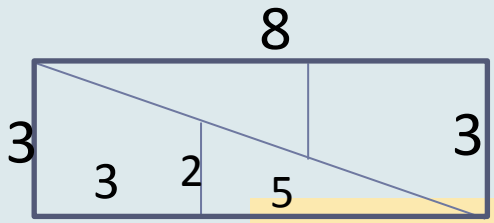
Area=169



Area=168



Area=25



Area=24

2 observations:

- *Fibonacci numbers*
- *area changes by ± 1*

This leads to an interesting generalization that helps us to better understand both this paradox puzzle and Fibonacci numbers, too.

1 1 2 3 5 8 13 21 34 55 89 144 ……

From the previous slide, we see that :

5 x 5 = 3 x 8 + 1

8 x 8 = 5 x 13 – 1

13 x 13 = 8 x 21 + 1

$$F_n^{\,2} = F_{n-1} \times F_{n+1} \pm 1$$

The square of any Fibonacci number is one more than or one less than the product of the two Fibonacci numbers on either side.

Fernando Mission, California

Copyright The Haines Photo Co., Conneaut, O.

These vanishing area puzzles so captivated people in the late 1800's that they, like Sam Loyd's circular puzzles, were used in many advertising campaigns.

These pictures are 10 inches wide and from 2 to 6 feet in length. We have views taken in your section of the country—views that will appeal to your customers.

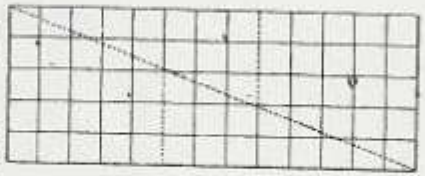
Let us send you particulars and prices in premium quantities.

We supply pictures for every purpose. We make up all kinds of special work to order from our own photographs or from photographs supplied by the customer.

For further particulars address

HAINES VIEWS, - - CONNEAUT, O.

And a New Puzzle



Good puzzles are always in demand. Nothing gets more attention or is more certain to be passed about from hand to hand and talked about. Our "Elusive Square" Puzzle has them all guessing. Made of four pieces of cardboard printed with squares. Arranged in one way, there are sixty-four squares; arranged another way, there are sixty-five squares. The puzzle—where does the extra square come from? A puzzle that appeals to the children and to the mathematically and scientifically inclined as well. Your ad printed right on the face of the puzzle.

A sample free to any business concern.

CHARLES SCHINDLER *Manufacturer of Ad Novelties that appeal to children* **Toledo, Ohio**

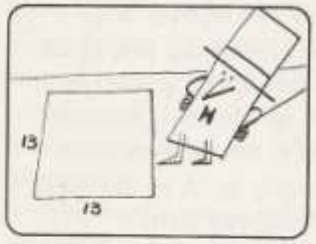
stand rolling and handling
count of its greater toughness
than the coated stock that it
for the straight lithographic
plate printing, we adopted
printing for the reproduction
"The calendars that we h
, 12x24, inc
d, of cours
homes, we
ing feature
alendar sit
ndars wer
e use of c
hroughout
es, skimmi
ays anxiou
play a De Laval calendar.

De Laval Calendar Is Advertisem

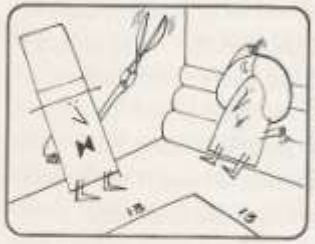
"It also seemed to us that f
stores and in such other pla
tioned, it would be better to
would feature our separators
nently. In other words, it s
some extent, to sacrifice art
with this idea in view, four c
adopted a second style of cal
tribution. Inasmuch as we
could get practically 100 per
tions and use for this calen
principal feature of the calend
style machines, and used a cal
20x50, with a very large pad.
"I do not believe we get
piece of advertising matter t
ally used or better apprecia
calendars. I know I do not
say that it is one of the bigge
tive calendars distributed to
our line. And while, of cour
tributed is not nearly so lar
small calendars, I believe that
for all the money we invest
medium.
"For the same reason tha

July 1916 N.N.

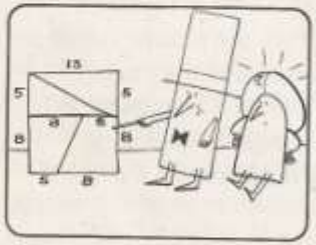
Randi's Remarkable Rugs



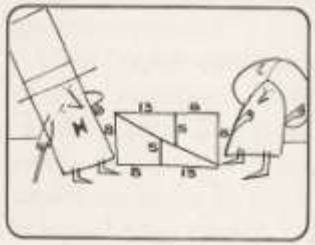
Mr. Randi, the world famous magician, owns a rug that is 13 decimeters by 13 decimeters. He wants to change it to an 8-by-21 rug. Mr. Randi took the rug to Omar, a rug dealer.



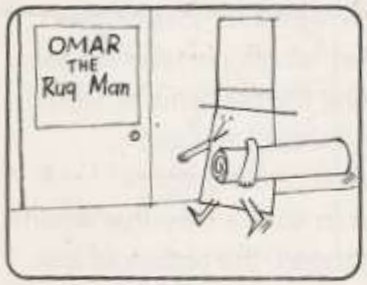
Randi: Omar, my friend, I want you to cut this rug into four pieces, then sew them together to make an 8-by-21 rug.
Omar: I'm sorry, Mr. Randi. You're a great magician but your arithmetic is terrible: 13-by-13 is 169, 8-by-21 is 168. It won't work.



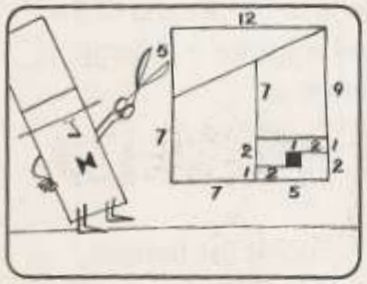
Randi: My dear Omar. The great Randi is *never* wrong. Kindly cut the rug into four pieces like this.



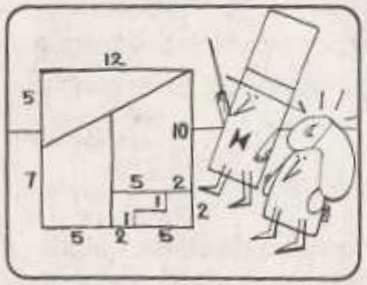
Omar did as he was told. Then Mr. Randi arranged the pieces, and Omar sewed them together to make an 8-by-21 rug.
Omar: I can't believe it! The area has shrunk from 169 to 168! What happened to that missing square decimeter?



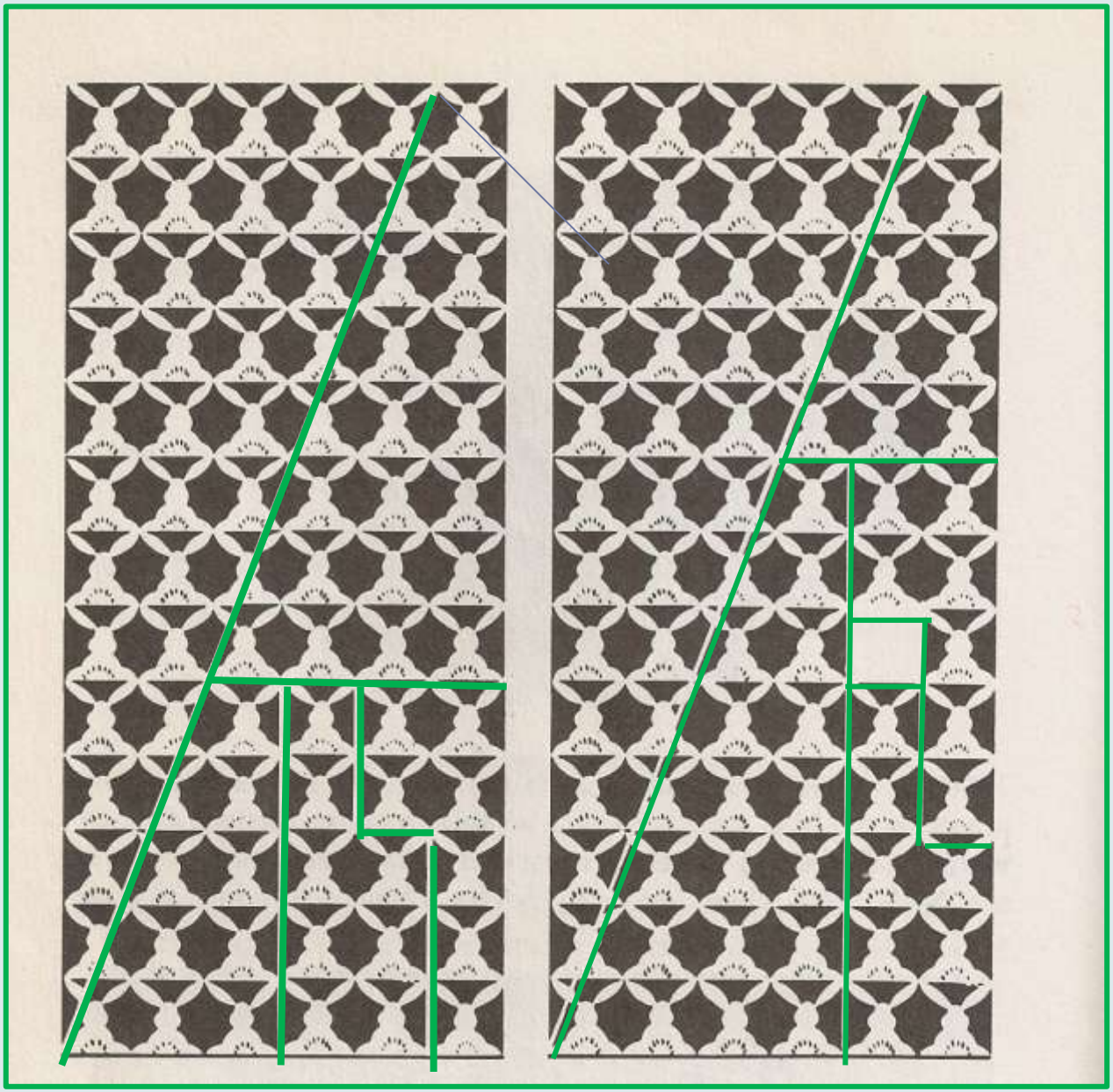
A few months later, Mr. Randi returned with a rug 12 decimeters by 12 decimeters.
Randi: Omar, old pal, my electric heater overturned and burned this beautiful carpet. By cutting and sewing, it will be easy to get rid of the hole.



Omar was doubtful, but he followed Mr. Randi's instructions. After the pieces were sewn together, the rug was still 12-by-12 but the hole had vanished!

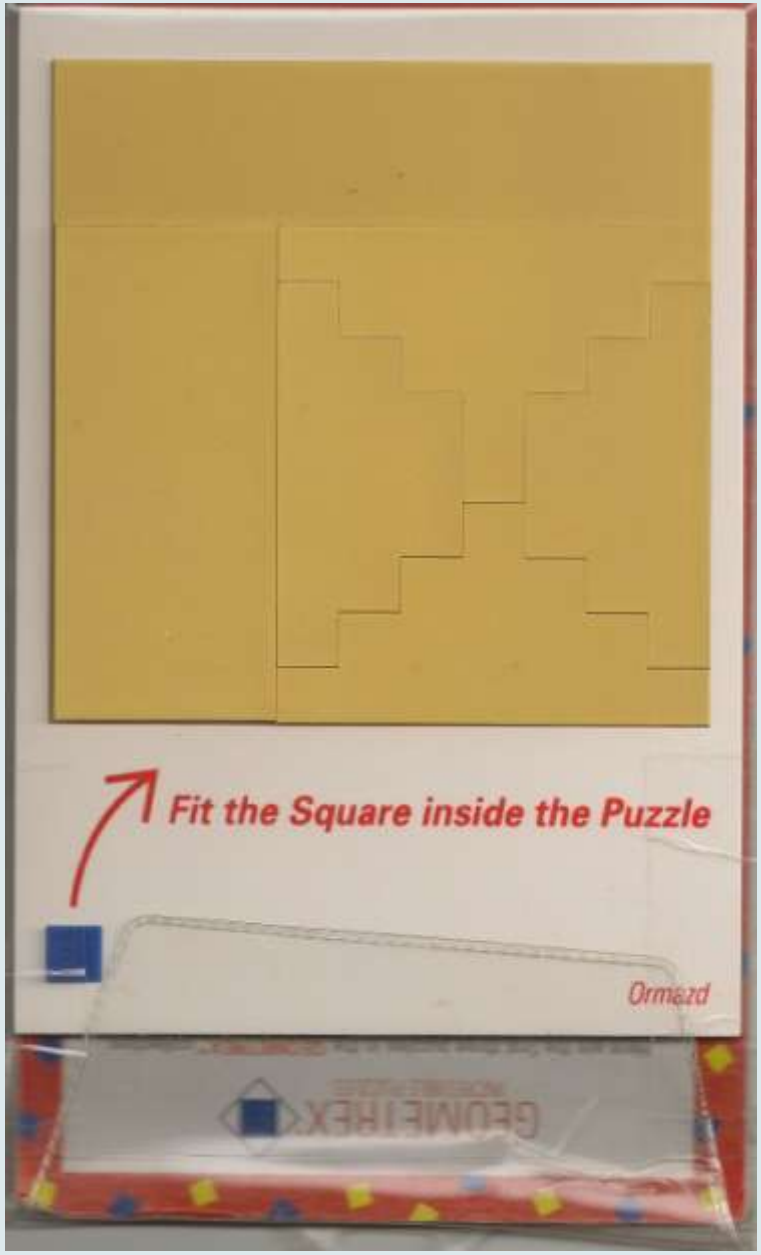


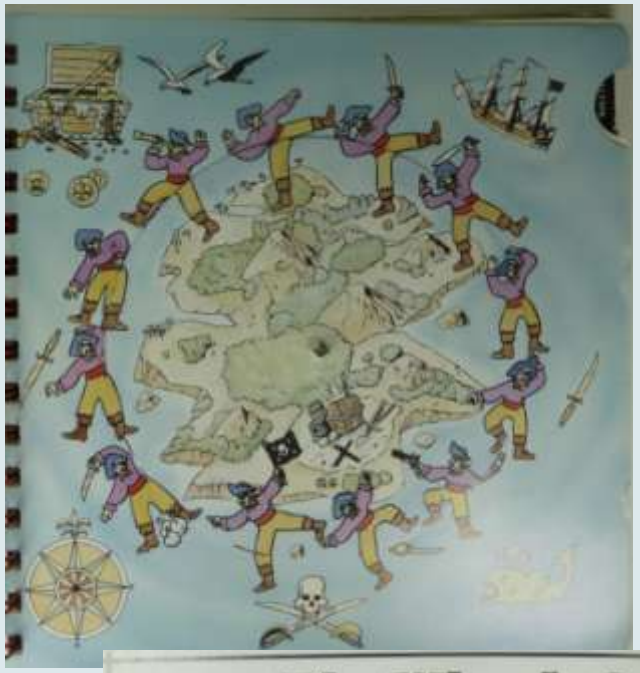
Omar: Please, Mr. Randi, how did you do it? Where did that square decimeter come from to fill the hole?



6 by 13 = 78 rabbits

6 by 13 = 77 rabbits and 1 rabbit hole


Fit the Square inside the Puzzle
Ormazd



Teachable moment: The more times you explain a concept, the better your explanations will get.

Slocum, 2011

Slocum, 1996

The Wheel of Disappearing Pirates pg. 15

Look at the hint again. If I had 12 full glasses of water, and put a little bit of each one into the empty 13th glass, at the end of it all, it would LOOK as if I magically filled 13 glasses with the water from only 12 full glasses. Of course I haven't. It's just that the difference is too small to pick up visually. With the disappearing pirates, the principle is the same. A little bit of each of the 12 pirates is all added up to make the 13th. Of course the art is carefully drawn to hide what's going on.

Cover: The Disappearing Bicyclist!

Notice when the arrow on the wheel points to A there are 13 boys and the first boy on the lower left is almost completely outside of the wheel. Each subsequent clockwise boy has been drawn slightly further toward the center of the wheel, until the last boy is almost all inside the wheel/tire. When the wheel section is rotated from A to B, 12 boys gain some part of their body and are ½ larger. So in reality no boy has actually disappeared.

DISAPPEARANCES

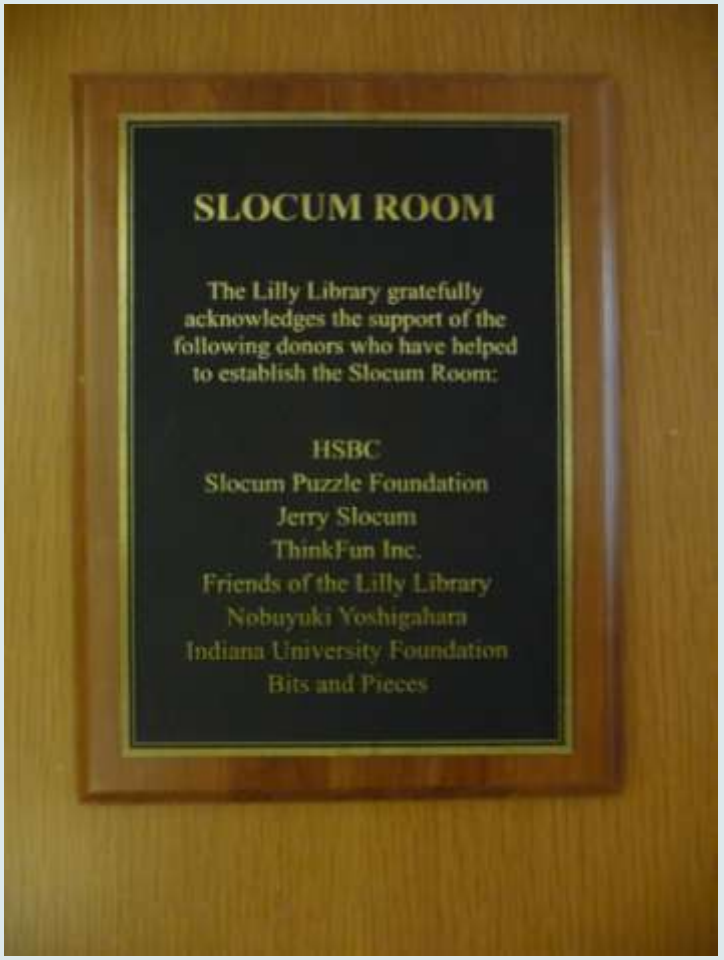
I wonder how magicians make their rabbits disappear;
not interfere
and facts of mathematics that are clear.
transport things as in dreams:
suspended, banished, null and void-or so it seems.
involve
a force that's able to dissolve.

Enchanted words like "hocus pocus" can
With laws of science
The prestidigitators, making use of devious schemes,
(although they never tell you how)
At times
There must be something secret, yes, a trick that will
-when done with sleight of hand-

Don’t Do This At Home!

According to Martin Gardner, in 1968 a man in London was sentenced to 8 years in jail for doing this with 5 pound notes.

The New Home for Jerry's Puzzles
The Lilly Rare Book Library at Indiana University, Bloomington



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