THE MAGIC CIRCLE

I knew there'd be trouble! I simply should have known better than to try to have a party without checking that there was the same number of boys and girls. Well, alright, not boys and girls exactly ..... my name's Merlin, and that's me sitting cross-legged in the picture.

You see, I did invite six wizards and six witches, as you can tell if you count us. What I forgot was that I brought the number up to thirteen. Thirteen! O dear, O dear.

The girls started muttering about sex discrimination, and before you could say mxtplocketty – (and that's one of the easiest magic words I know) – there were spells and incantations flying all over the place.

You can find out what happened if you follow these instructions:–

1. Draw in the rest of the "magic circle" – the centre is marked for you – and cut around it (carefully, you don't want to spoil the magic!) If you prefer not to spoil your "pie", you could trace the picture inside the circle – or better still, buy an extra magazine!
2. Turn the inside part of the picture so that the two lines "ABRACAD" and "ABRA" match together.
3. Count us. Still thirteen? O dear! – But HOW MANY WITCHES?!!

E.G.

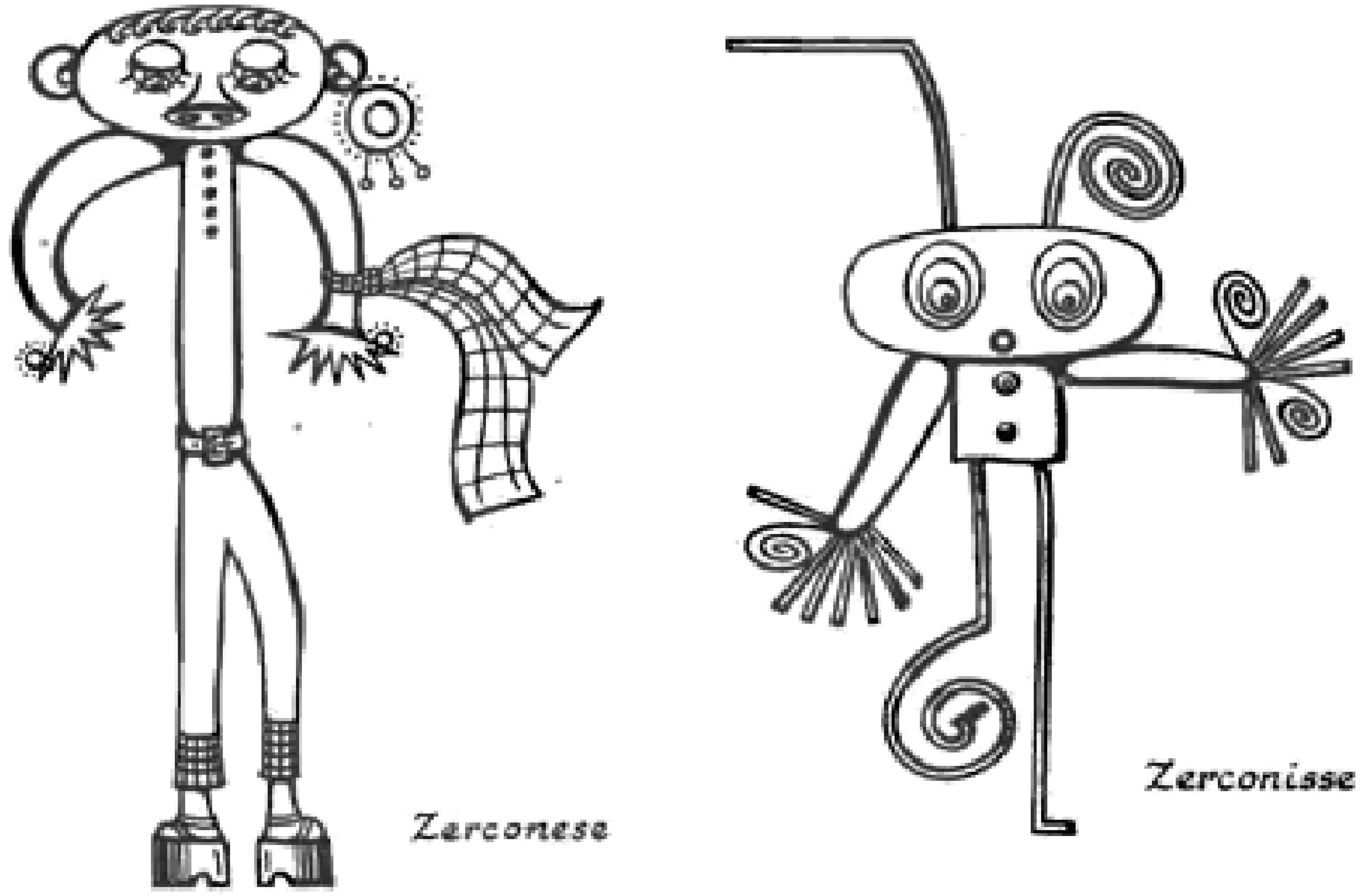
MATHEMATICAL PIE

No. 85 | *Editorial Address :* West View, Fiveways, Nr. Warwick | AUTUMN, 1978

STELLAR MULTIPLICATION

First Officer's Log Stardate 9776.

We have discovered an interesting phenomenon on the planet Zercon, i.e., that there are two different forms of intelligent life. The Zerconese are a human-like race with seven fingers on each hand and they do all their counting

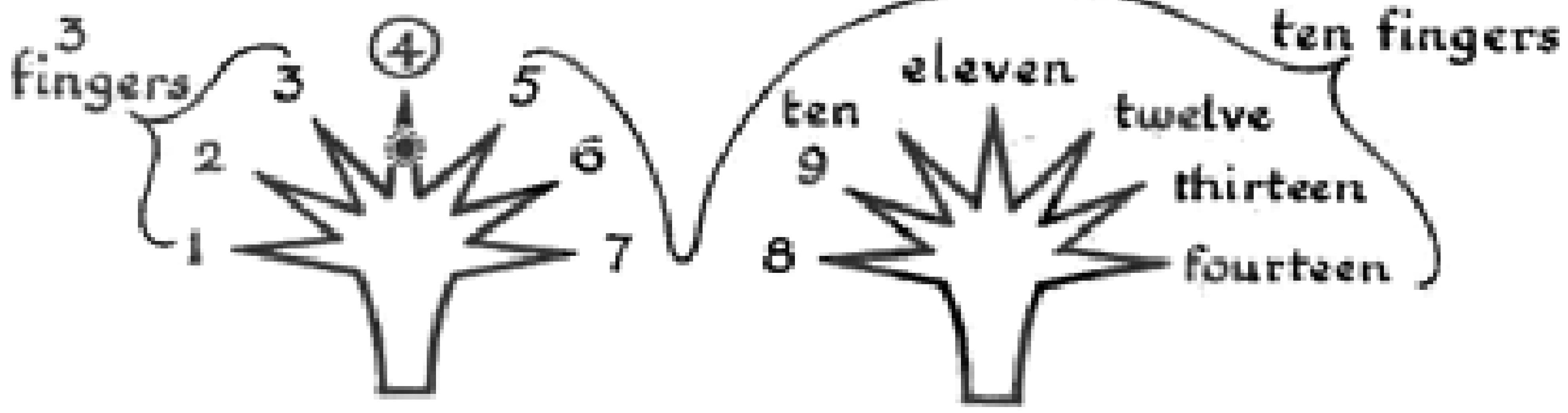


and number work in base fourteen. The Zerconese children are taught at school that a quick way to multiply a number (say, n) by 13 is as follows: they hold out their hands in front of them and imagine their fingers numbered 1 to 14. They then place a ring on the nth finger and count the number of fingers in front of and behind the ring. These two numbers are the digits of the answer.

continued overleaf

Stellar multiplication continued

e.g. multiply 4 by 13

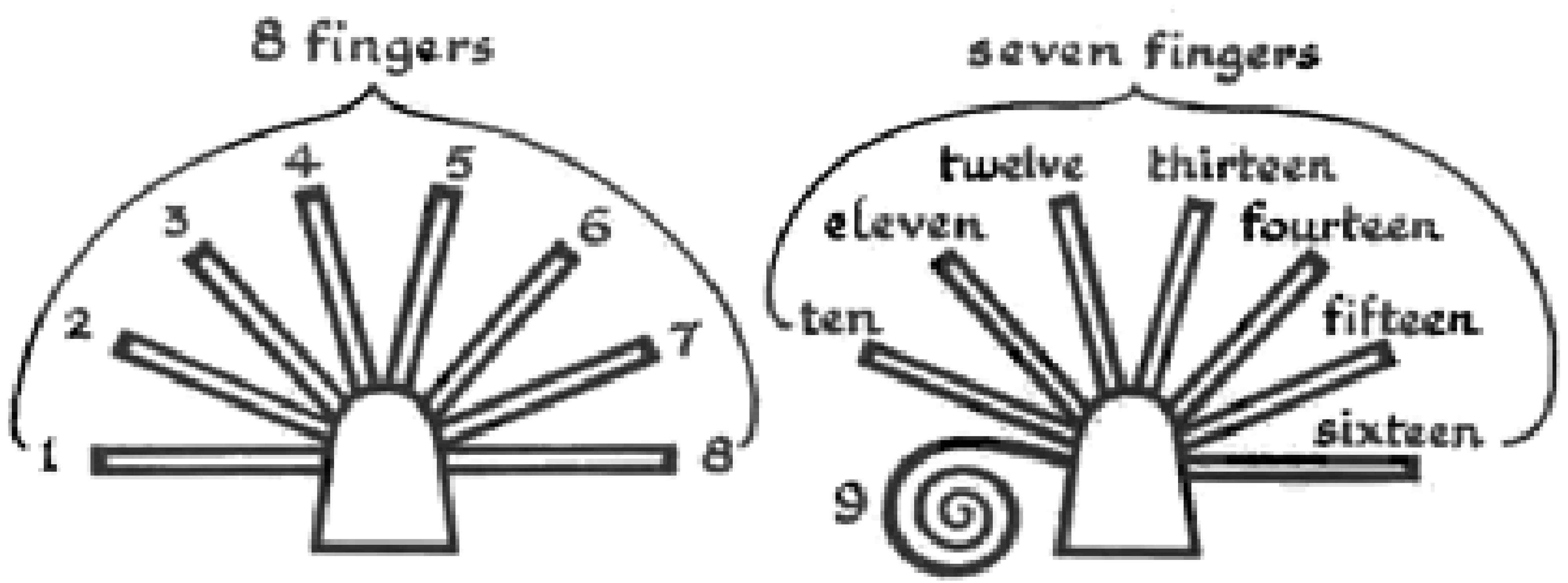


$4 \times$ thirteen $= 3$ ten (base 14) $= (3 \times 14) + 10$ (base 10)

$= 52$ (base 10)

The other race on Zercon are the Zerconisse, a curious race with spiralling antennae, legs and fingers. The Zerconisse have eight fingers on each hand and use a similar method to the above to multiply by 15, in base sixteen, of course. To do this they spread their hands out, imagine them numbered from 1 to 16. They then curl up the nth finger and count the number of fingers left on either side. These are the digits of the answer.

e.g. multiply 9×15



$9 \times$ fifteen $= 87$ (base 16) $= (8 \times 16) + 7$ (base 10)

$= 135$ (base 10)

Why is it true that, in general, this method can always be used for multiplying by $x-1$ in base x?

How can we make use of the method in base ten?

A.M.A.

NO DEAL! (But it makes a change)

The other day, I was asked if I could change a 50 pence piece. To my surprise, despite the fact that I had more than 50 pence in coins, I couldn't make an exact 50.

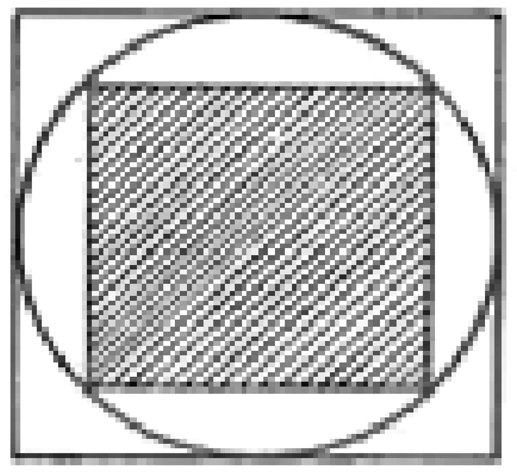
Can you find several different ways that this might happen?

What is the largest amount I could have had in coins without being able to change 50p?

E.G.

USE YOUR JUDGEMENT

A circle is drawn round a square and a second square drawn with its edges touching the cirlce. Quickly now – which of these is correct:–



a) The unshaded portion is half the shaded.
b) The shaded portion is half the unshaded.
c) The shaded and unshaded parts are equal.
d) The shaded portion is 1½ times the unshaded.

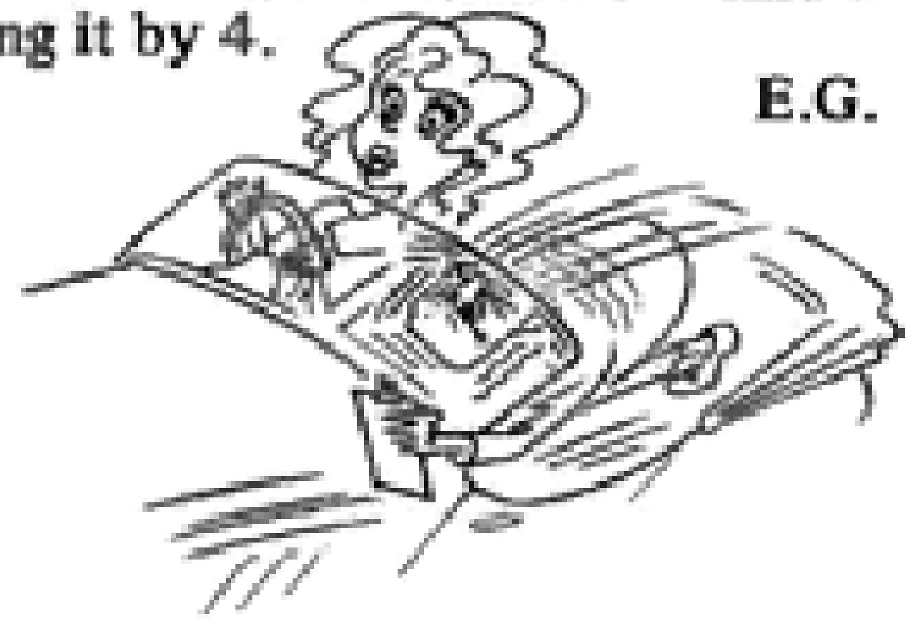
E.G.

REVERSE GEAR

Can you find a five-digit number which has its digits completely reversed by multiplying the number by 9?

If you think that was easy, here's one that's twice as difficult:– find a five-digit number that is reversed by multiplying it by 4.

E.G.



Solutions to problems in issue No. 84

Sum thing wrong Fibonacci? The numbers form a Fibonacci sequence. The extra unit of area arises from the fact that a space is left along the diagonal.

Smile please Every inverse relationship has this property.

Sporting life 8 rabbits and 32 birds.

Cubes The sum was $3^3 + 4^3 + 5^3$ which is 216 or 6^3.

Not so obvious

If a and b are positive numbers, $\frac{-a}{b} = \frac{b}{-b}$ but $-a$ is less than b and $-b$ is less than a.

Long Winter Evenings

Cutie Pie would never finish the scarf as there would always be half of the remainder left.

Powers and Primes Cross Figure

Clues Across: 1. 614656, 7. 1331, 8. 32, 10. 36, 13. 2197, 15. 371291.

Clues Down: 1. 613, 2. 1321, 3. 43, 4. 61, 6. 67, 9. 1399, 11. 671, 12. 83, 13. 21, 14, 12.

Square One, Square Two.

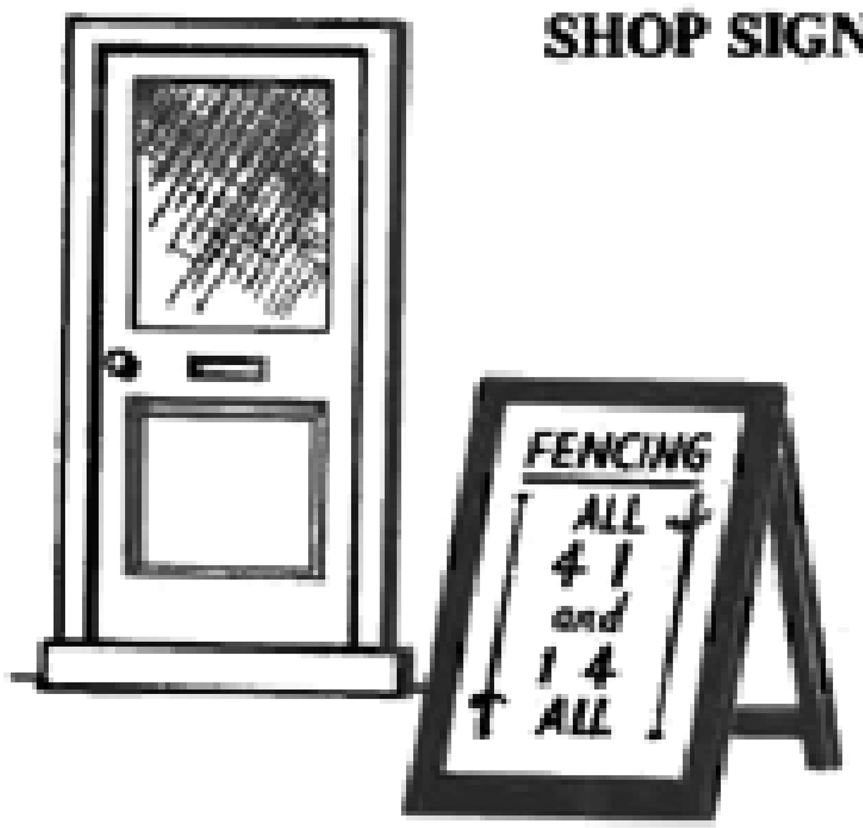
The squares had 26 metres and 38 metres sides.

Treasure Trove.

Barrel D contained the treasure.

B.A.

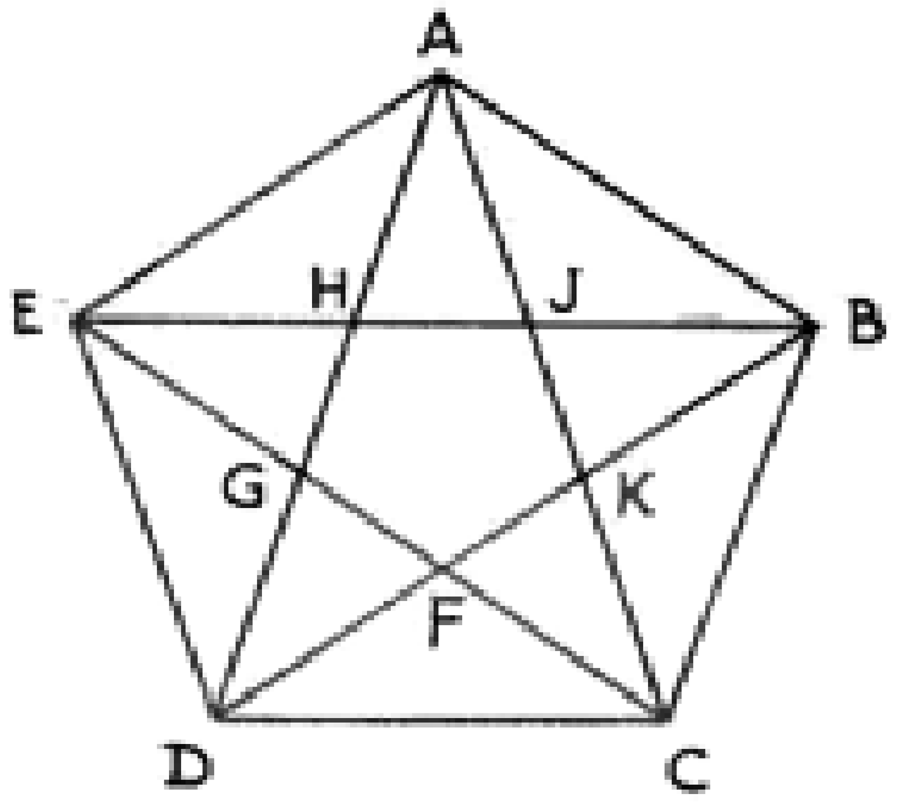
SHOP SIGNS!



PENTAGONS AND TRIANGLES

How many triangles can you find in the diagram which consists of a regular pentagon and all of its diagonals?

B.A.



THE PINT THAT THINKS ITS A QUART

A publican made up a new glass in which each length was double the corresponding length of a pint glass. What was the volume of beer that it would hold? What was the ratio of the area of the bottom of the new glass and the area of the bottom of the pint glass?

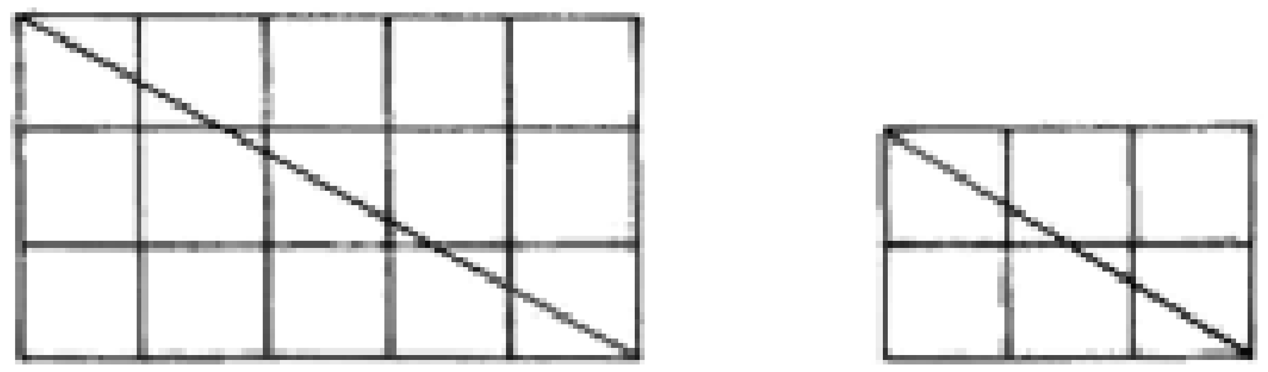
B.A.

DIAGONALS

The diagram shows two rectangles made up of unit squares. The width and length have no factors in common (except of course "one"). Other rectangles fitting this rule would be, for example, 3 by 4, 3 by 7, 4 by 5 but not 2 by 6, 4 by 6 nor 3 by 9 rectangles.

If one diagonal is drawn across a rectangle of this type, investigate how many squares are cut by the diagonal and how many remain intact. If there were w squares along the width and l squares along the length, can you find formulae for the cut squares and the intact squares?

E.G.

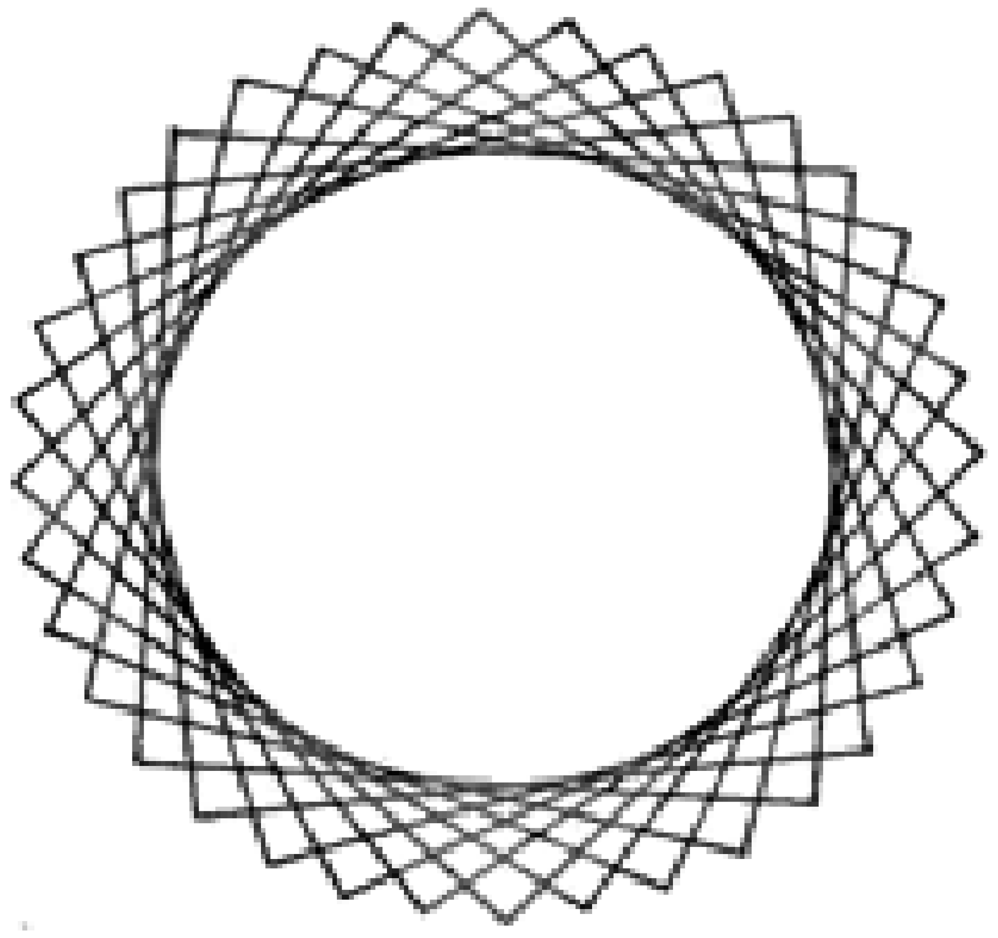


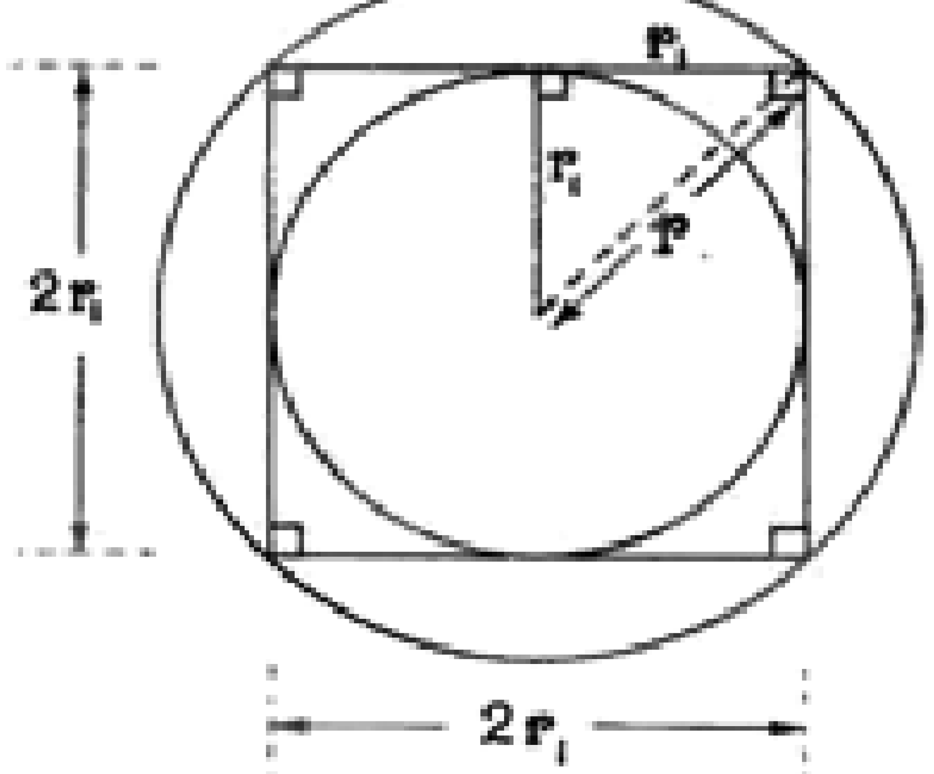
THEOREM IN STITCHES No.2

(submitted by Karen Jones, Heron Brook C.E.(C) Middle School, Gnosall, Stafford).

Draw a circle and space round it 36 points at intervals of 10^{o}. Think of the points as being numbered 1 to 36. Stitch from 1 to 10, 2 to 11 and so on.

The theoren is:– A square drawn inside a circle of radius r generates a circle of radius r_1 such that $r_1 = r/\sqrt{2}$

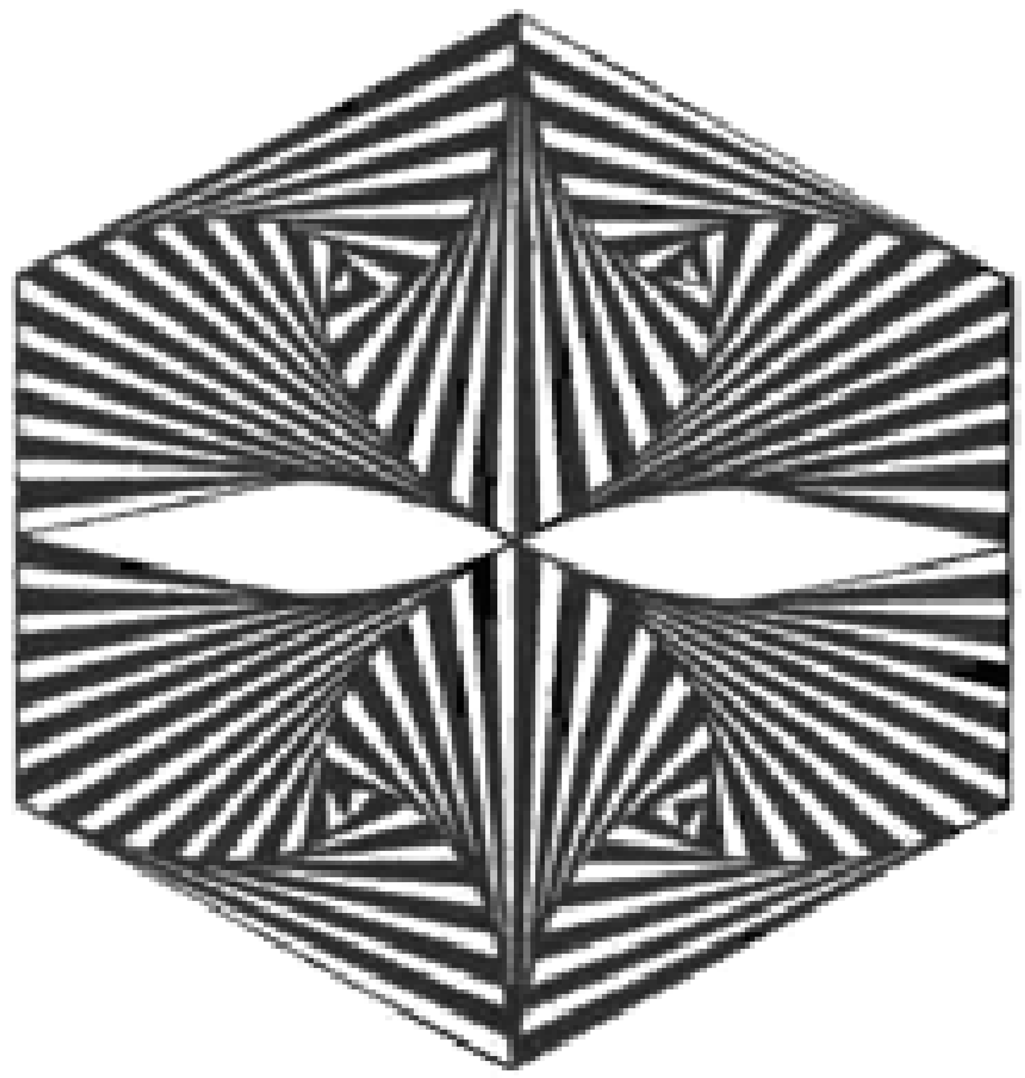




GENIUS

GENESIS

(submitted by R.Rickell, The City School, Lincoln)



THERE ARE THREE SIDES OF ANY PROBLEM

Side 1: An investigation

If each angle of an equilateral triangle is either left blank, marked with one dot or marked with two dots, how many different triangles can be made? Two markings are regarded as the same if one is a rotation of the other, but different if they are mirror images of each other. Make a complete set of the triangles from card and try these ideas:–

Side 2: A "jigsaw"

There are only two triangles which are a "mirror-image" pair: Put these two to one side. The remaining triangles can be fitted edge to edge to make a larger triangle. Can you arrange the triangles so that the three trapezium-shaped strips at the edges of the large triangle all have the same number of dots?

Side 3: Thriminoes

As the name suggests, this is a form of dominoes (played with a complete set of triangles). Place the triangles face down, mix them, leave one on the table and share the rest between yourself and an opponent.

Turn the triangle on the table face up. If its total of dots is odd, the person who turned it over starts, if it is even the other player starts.

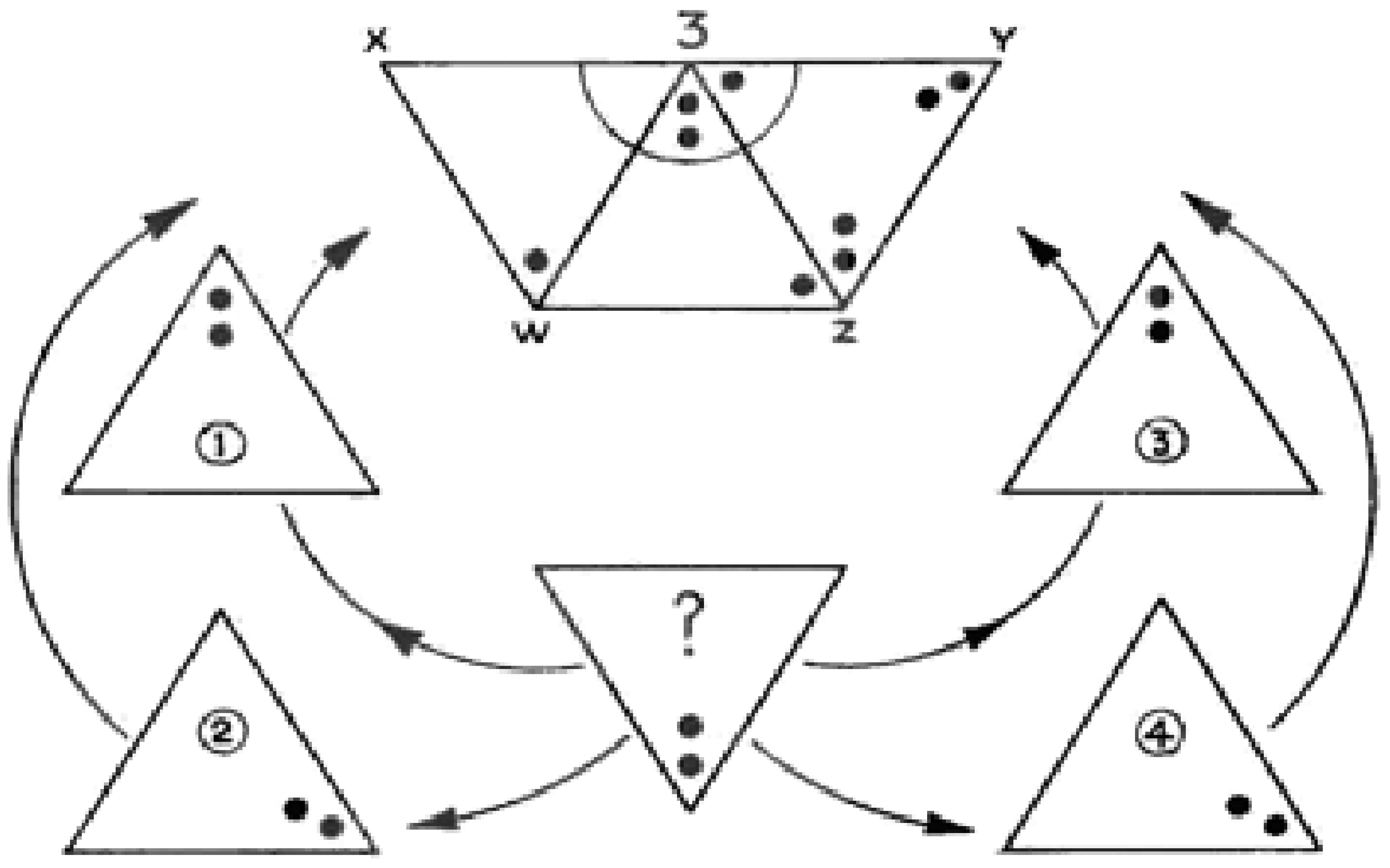
The players take turns to choose one of their triangles and place it edge to edge with the triangles already played. (The first player places a triangle next to the one which is already on the table). The first two triangles are relatively unimportant – it is at the third triangle that two important rules begin to have an effect:

a) After the third triangle has been played, the cards always form a trapezium-shaped strip and only the ends of this strip can be played on

b) Any three angles which are adjacent (making a straight edge, of course) must have a TOTAL of EXACTLY THREE DOTS.

Of course, if one player cannot go, he loses his turn. If a player gets rid of all his triangles, he has won. If neither player can go, the winner is the one with the lower total of dots.

The beginning of the game is shown in the diagram, where play is developing to the left and right.



The next player has blank, blank, two and is considering ways that he might play it.

1. Cannot be played since it would leave a straight edge at W with only on dot.
2. Makes a "line-3" at W and by making no dots so far at X, makes it impossible for anyone later to play at the left end (there are no three-dot angles).
3. Complete a "line-3" at Z and by making a total of four dots at Y, "blocks" any further moves at the right end.
4. Completes a "line-3" at Z and leaves play open at both ends.

E.G.

ENCOMPASSED SOLUTION

1. With centre O and any radius draw a circle. Mark a point A.
2. With centre A and the same radius draw an arc to cut the circle at B, continue round the circle with centres B and C and the same radius up to D.
3. With centre A and radius AC draw an arc and with centre D and the same radius draw another arc to cut the first at E.
4. With centre A and radius OE, draw an arc to cut the circle at F and G. AFDG is a square.