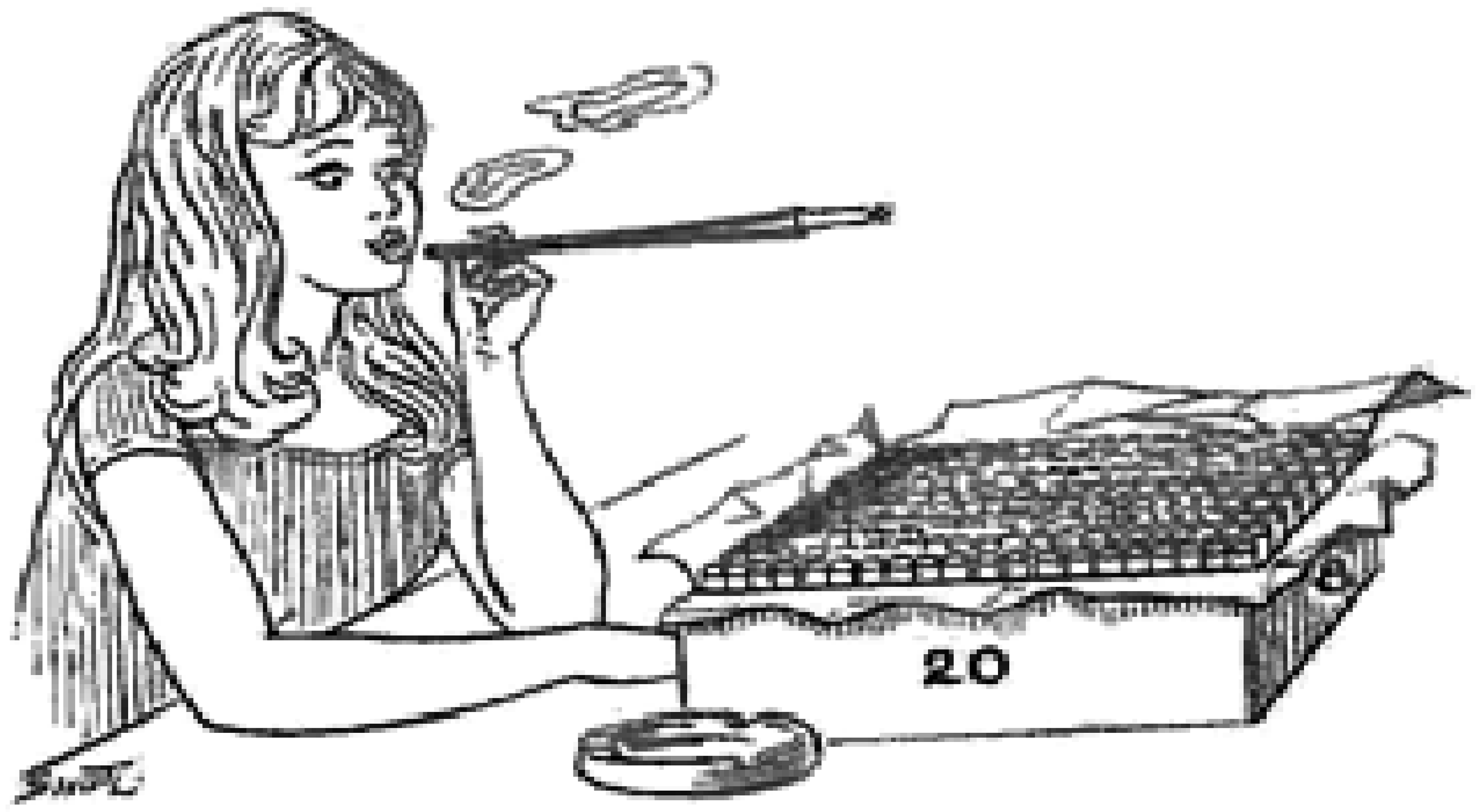
PACK 'EM IN

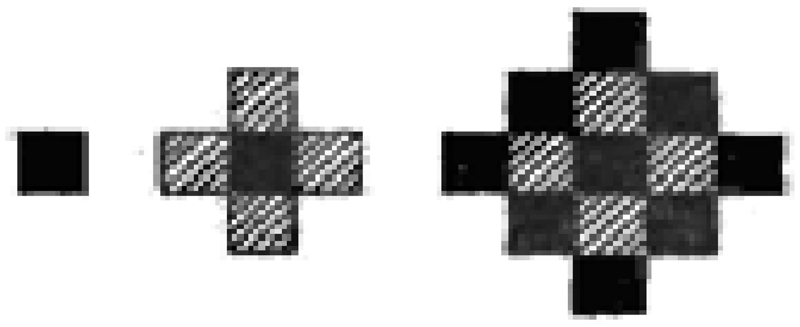


Cutie Pie has a box of 160 cigarettes, packed in eight rows of twenty in a row. Can you re-arrange the contents so that the box will hold more cigarettes of the same size?

R.H.C.

GROWTH

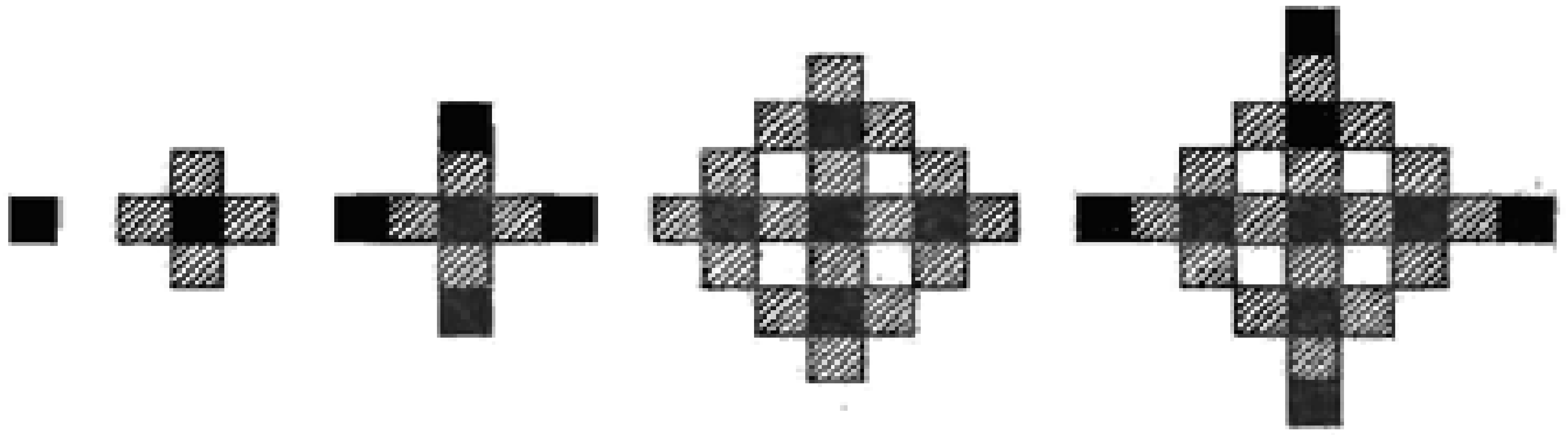
(a) Start by shading one small square on a sheet of graph paper. In a different colour, add a new square on each free edge of the first. Continue adding squares on free edges as below.



and so on

Can you find a rule for how many squares are added each time?

(b) A variation of the above idea produces more interesting shapes. Instead of adding squares to every free edge, only add a square in a space which is next to a *single* edge (spaces which are next to two or more edges stay empty).



and so on.

The pattern of growth is not so easy to describe this time, but if you continue far enough there are some surprising repetitions! If you like, you could start with a pattern of squares instead of one.

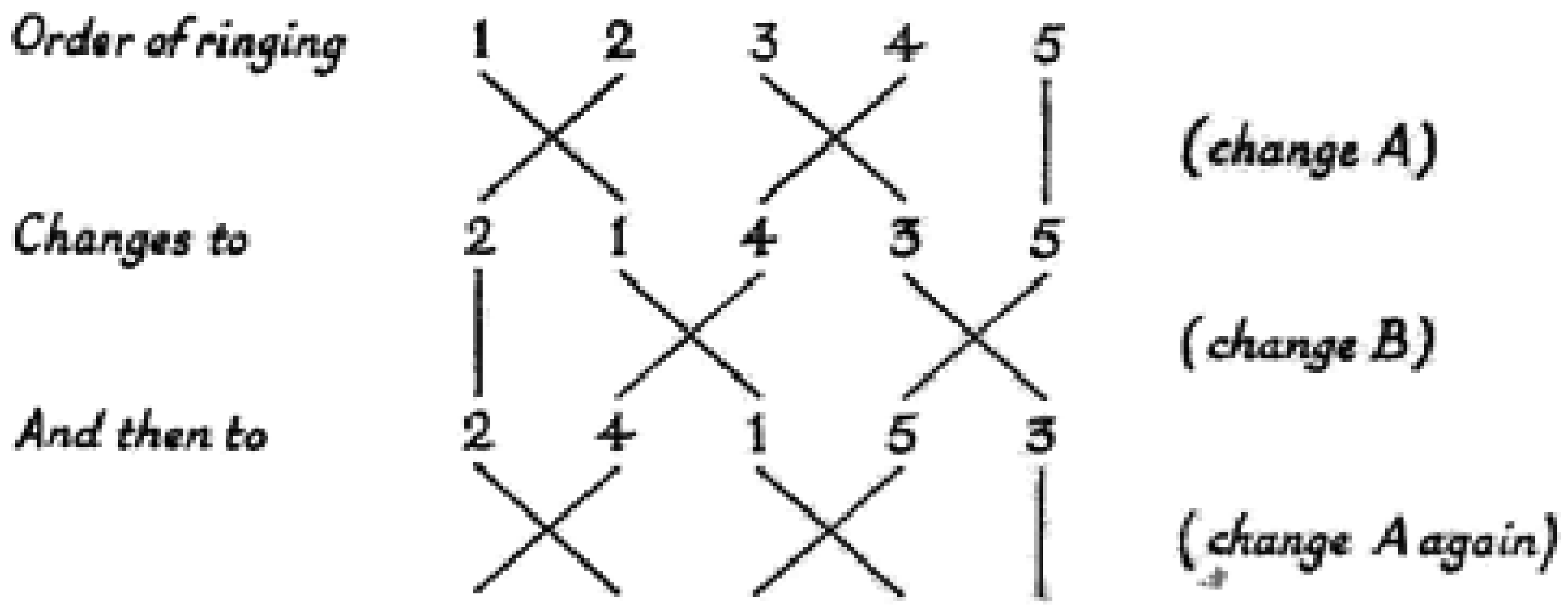
E.G.

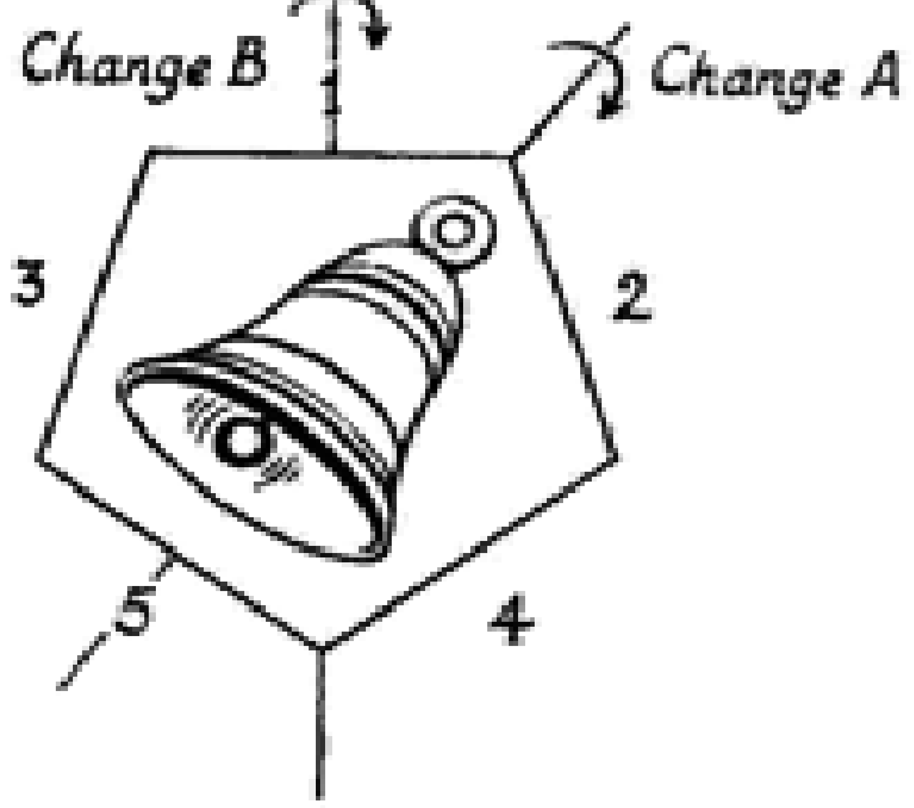
join the mathematical pie

No. 75 | *Editorial Address:* West View, Fiveways, Nr. Warwick | SUMMER, 1975

PLAIN ENOUGH?

In the bell-ringing peal known as a " Plain course of plain bob doubles ", the order in which five bells ring is changed in this way :—



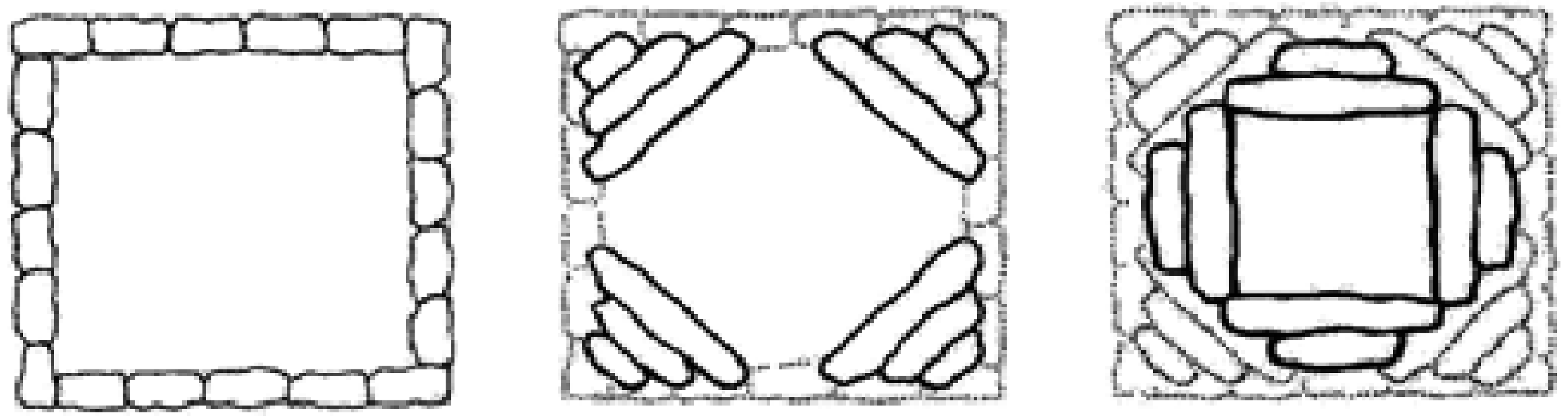


The two changes A and B continue to alternate (as suggested by the XXI under the last row). How many times will each bell ring before the sequence begins to repeat? You might like to make a card like this and by turning it over check that the same " peal " results.

E.G.

HOWE ?

The rocks of Orkney split easily into slabs which can be used for door posts and lintels. Stone-age men used these in their buildings but roofs were a little difficult. The Arch was unknown. The builders tapered their walls inward as much as they dared, but this still left a space too wide to be spanned by any stones which they could quarry. The difficulty was overcome by placing stones across the corners of the building. This left an irregular octagon. More stones parallel to the walls left a smaller square. Continuing in this way the roof could be completed and topped off with turf.



How large a square could be roofed over if stones with a span of six feet could be quarried?

C.V.G.

FUN WITH FIGURES

A number consists of 22 digits and the last one is 7. When the 7 is moved to the front of the number from the end, the number is increased to seven times its original value. Find the number.

R.H.C.

FOOD FOR THOUGHT

Seven boys visited the seaside and caught 4 crabs in 6 days of the holiday. 21 boys from the local school, hearing of this, searched but found only one crab at the same rate of success. For how long did they search?

R.H.C.

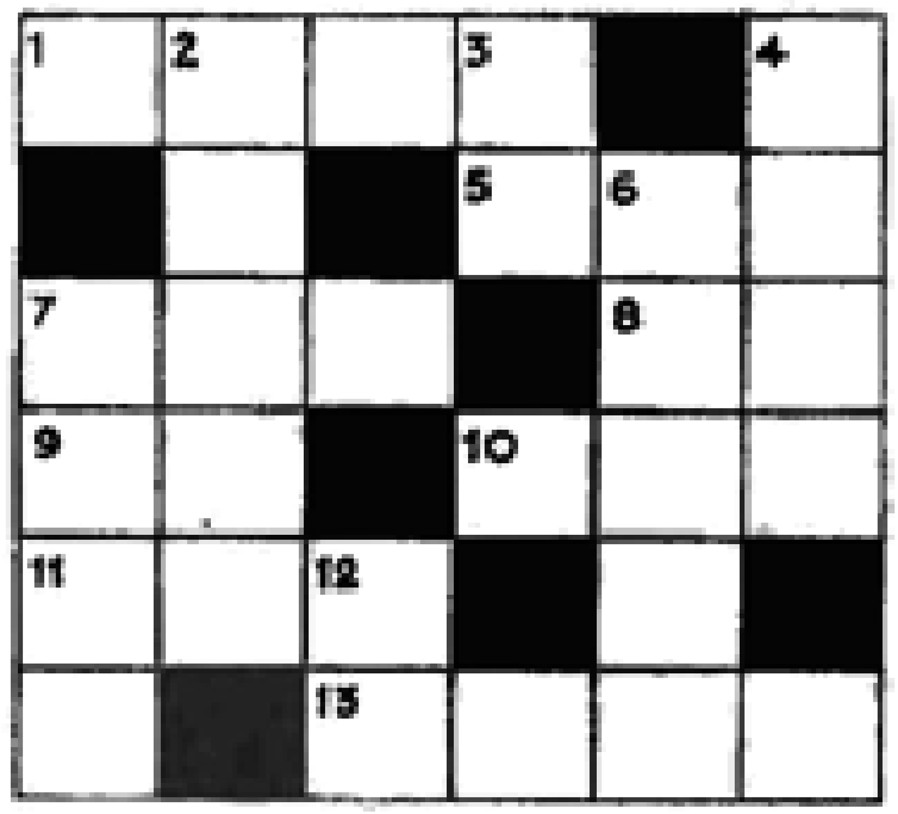
SQUARE SEARCH

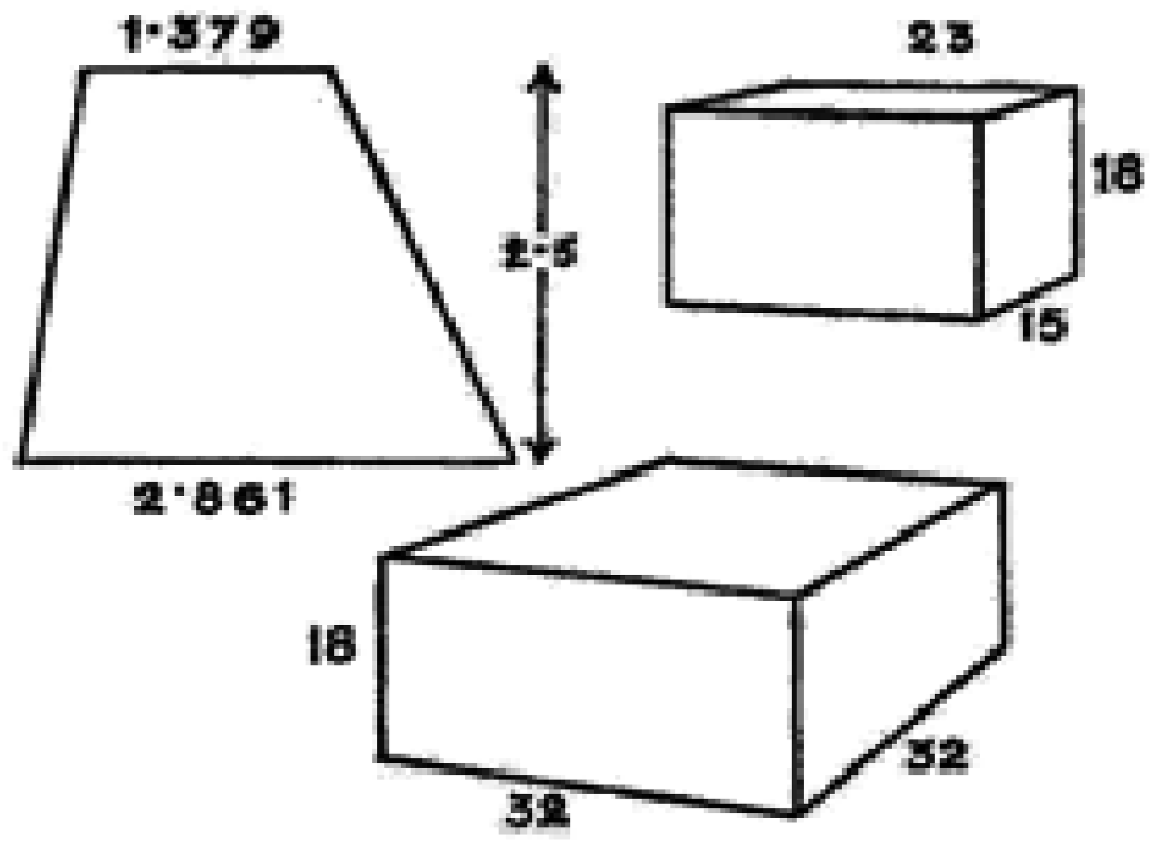
1	9	17	25	33	41	49	57
2	10	18	26	34	42	50	58
3	11	19	27	35	43	51	59
4	12	20	28	36	44	52	60
5	13	21	29	37	45	53	61
6	14	22	30	38	46	54	62
7	15	23	31	39	47	55	63
8	16	24	32	40	48	56	64

Start at number 46 and by travelling in straight lines pass through each number once only, ending on number 19. What is the smallest number of lines necessary?

R.H.C.

JUNIOR CROSS FIGURE No. 66





Clues Across

1. Not the date of the first Pie, but the number of pies times the age of Pie.
5. Missing number if the average (or mean) of 1,2,3 and – is 57.
7. Product of the even numbers less than 10.
8. abc, if $2a+3=13$, $\frac{1}{4}b+2=3$, and $3c-5=1$.
9. The value of $2x^2+6x+10$ if x is the last digit of 1 across.
10. The only perfect square between 900 and 1 000.
11. North-East?
13. Sum of all the perfect cubes from 1 to 1 000 inclusive.

Clues Down

2. $2^2 \cdot (10^2+7^2)^2$.
3. The number of years in 2 704 weeks.
4. Sum of the page numbers of the centre pages of issue No. 65, with the digits reversed (Yes, we do have the same number of pages each issue, except No. 1).
6. Palindromic volume of the two boxes above.
7. Circumference of a circle whose radius is 6·215 m (Use $\pi = \frac{355}{113}$).
12. Area of the trapezium.

E.G.

SOLUTIONS TO PROBLEMS IN ISSUE No. 74

SQUARING UP

It is one half.

ANAGRAMATH CROSSWORD

Clues Across: 1. Pythagoras, 5. Hypothesis, 10. Tear, 11. Ears. 12. Spans miles, 14. In terms of c.

Clues Down: 1. Path, 2. Hypotenuse, 3. Other sides, 4. Sums. 6. Yelp, 8. Harm, 9. Isle, 12. Semi, 13. Sine.

A PRIME CROSSFIGURE

Clues Across: 3. 24, 5. 16, 6. 810, 7. 60, 8. 81.

Clues Down: 1. 12, 2. 66, 4. 480, 5. 108, 7. 66, 9. 11.

B.A.

ring of rhombi has the rotation in the same sense, order again produces beauty. This time, we have two possible patterns as shown with the rings of five rhombi. The pattern formed with curves of pursuit fitted into three rhombi with 60° and 120° angles is particularly attractive.

The preparation of these designs is purely mechanical but they can be embellished in many ways. They could be used as the framework of thread sculpture as described in issue No. 72. Alternate regions of the design can be blocked in to produce striking patterns, see issue No. 64, or shading used to bring out the three dimensional effect of the patterns as shown in the two diagrams.

The editor would be pleased to receive examples of designs and will award book tokens for any that are used.

B.A.

CALCULATORS

John Napier and Henry Briggs based their theory of common logarithms on the number of digits obtained when a number was raised to the ten thousand millionth power. With any desk calculator we can adapt this idea to calculate common logarithms with rather less effort than was required in 1615.

For example, to find the common logarithm of 3 we used the " constant multiplier " facility to obtain $3^{10}=59049$.

Taking out the factor 10^4, $3^{10}=10^4\times 5{\cdot}9049$.

Raising 5·9049 to the tenth power $3^{100}=10^{40}\times 51537752{\cdot}07$

$$=10^{47}\times 5{\cdot}153775207.$$

If, unlike Napier and Briggs, we are satisfied by logarithms to six figures, we call a halt when we reach $3^{1\,000\,000}=10^{477121}\times 1{\cdot}794\ldots\ldots$ Hence $3=10^{0\cdot477121}\ldots\ldots$ and $\log 3=0{\cdot}477121\ldots\ldots$

C.V.G.

SPOT THE ERROR

$x^2+x+1=0$ can be re-written as $x(x+1)=-1$ or as $x+1=-x^2$. Hence $x(-x^2)=-1$ which leads to $-x^3=-1$ and $x=1$, so that the original equation gives $1+1+1=0$ or $3=0$.

R.H.C.

DOUBLE TOP

Take the set of numbers 1 to 11 inclusive and arrange them into five subsets, not using any element more than once. Put in necessary signs and powers of 2 so that each subset is equivalent to any other. And don't forget the title.

A book token will be sent to the sender of the first solution received.

R.H.C.

HONOURS EVEN

Take the picture cards and aces of the four suits of a pack and arrange them in a four by four square so that no value or suit appears twice in any row or column or either of the two main diagonals of the square.

P.J.G.

SOME +
MORE
FULL

The letters of the addition on the left are replacements for eight figures. There are several solutions to the problem. A book token will be sent for the most solutions.

R.M.S. C.V.G. P.J.G.

A SIMPLE ARRANGEMENT

Can you use a digit five times so that the sum of the numbers so formed is fourteen ?

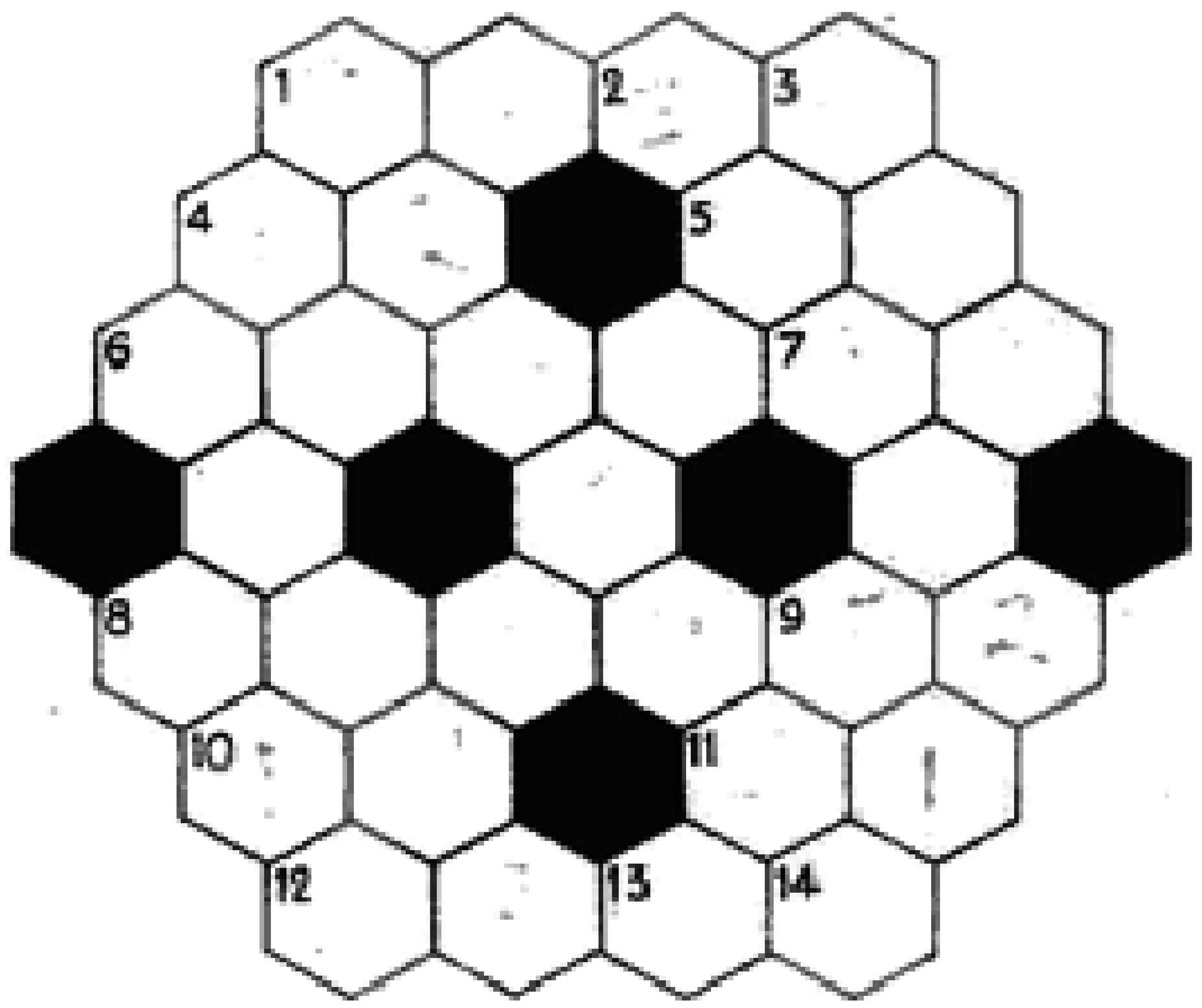
R.H.C.

A TON

Using five ones you can make 100 as $100=111-11$. Similarly, five fives give $100=5(5+5+5+5)$. Can you make 100 with five 2's, 3's, 4's ?

R.H.C.

HOW DOTH THE BUSY PUZZLER?



A Senior hex-figure with three sets of clues. Do it by ignoring whichever set you choose!

CLUES → ACROSS

1. $\frac{b}{2}+\sum_{r=0}^{r=5} b^r$.
4. Two bee.
5. $\left(\frac{b}{2}\right)^{b-2}$
6. Three bees precede an emergency.
8. Area of one cell if its sides are one unit; work to six figure accuracy and reverse the digits.
10. Number of cells completely within the hive.
11. Is just 10 across in base bee.
12. r,s,t,u if $\frac{7x^2-18x+14}{(x-1)^2(x-2)^2}=\frac{r}{x-1}+\frac{s}{(x-1)^2}-\frac{t}{x-2}+\frac{u}{(x-2)^2}$.

CLUES ↘ DOWN

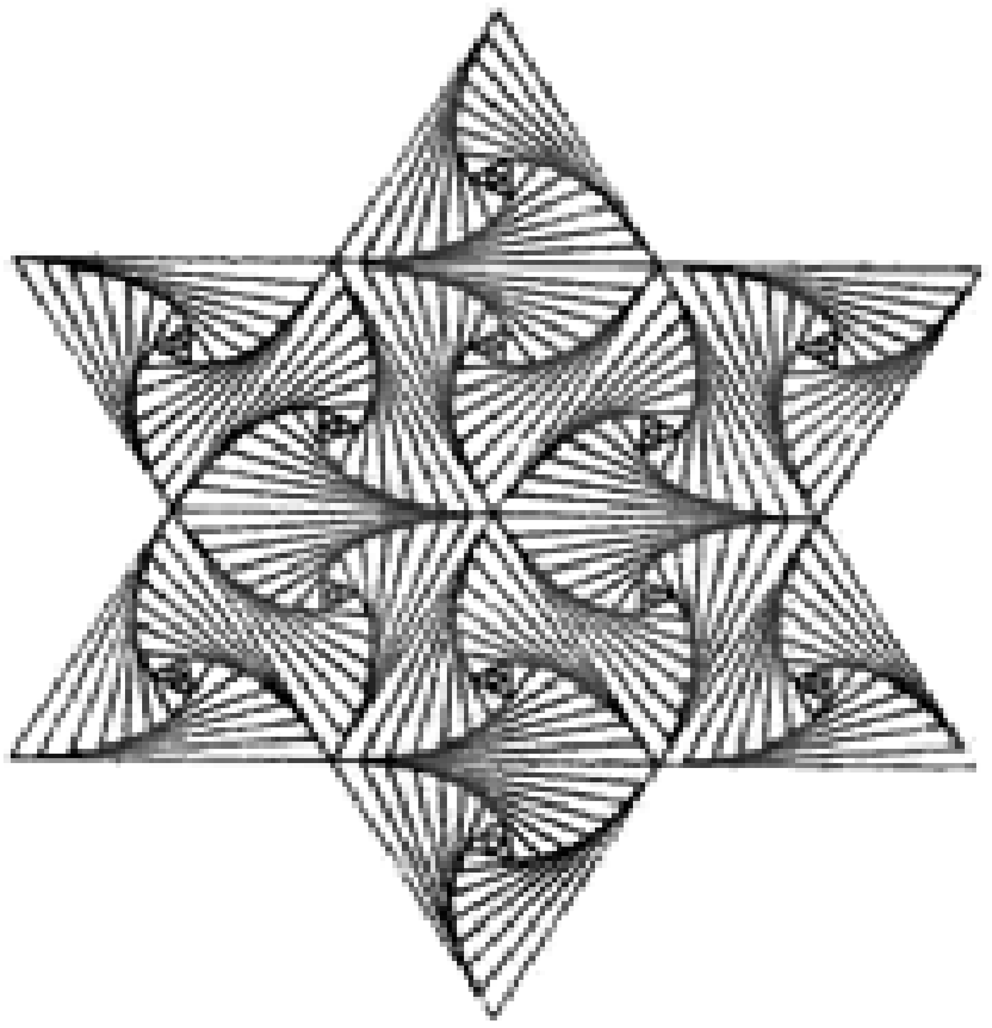
1. $[(b-1)^2(2b-1)^2+3b+1]^2$.
2. Second, then third terms of $t_n=n(n-1)^n\,t_{n-1}$, given that t_1 is 10 across.
3. Six up, two hundred down.
4. Beeteen ?
6. $b!\times 96-\left(\frac{b}{2}\right)^3$.
8. Fourteen up, two hundred up.
9. $\begin{vmatrix} 2b & 7b \\ \frac{1}{2} & b \end{vmatrix}$

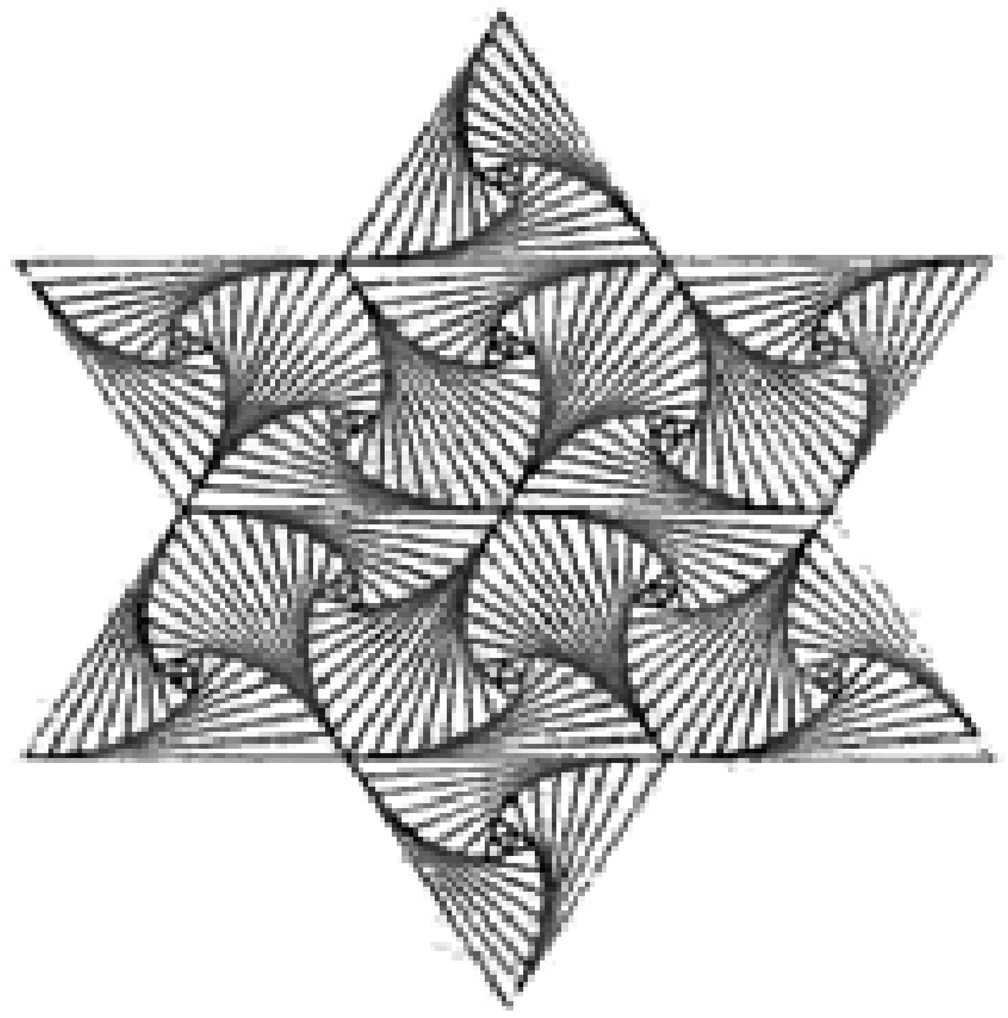
b = 6

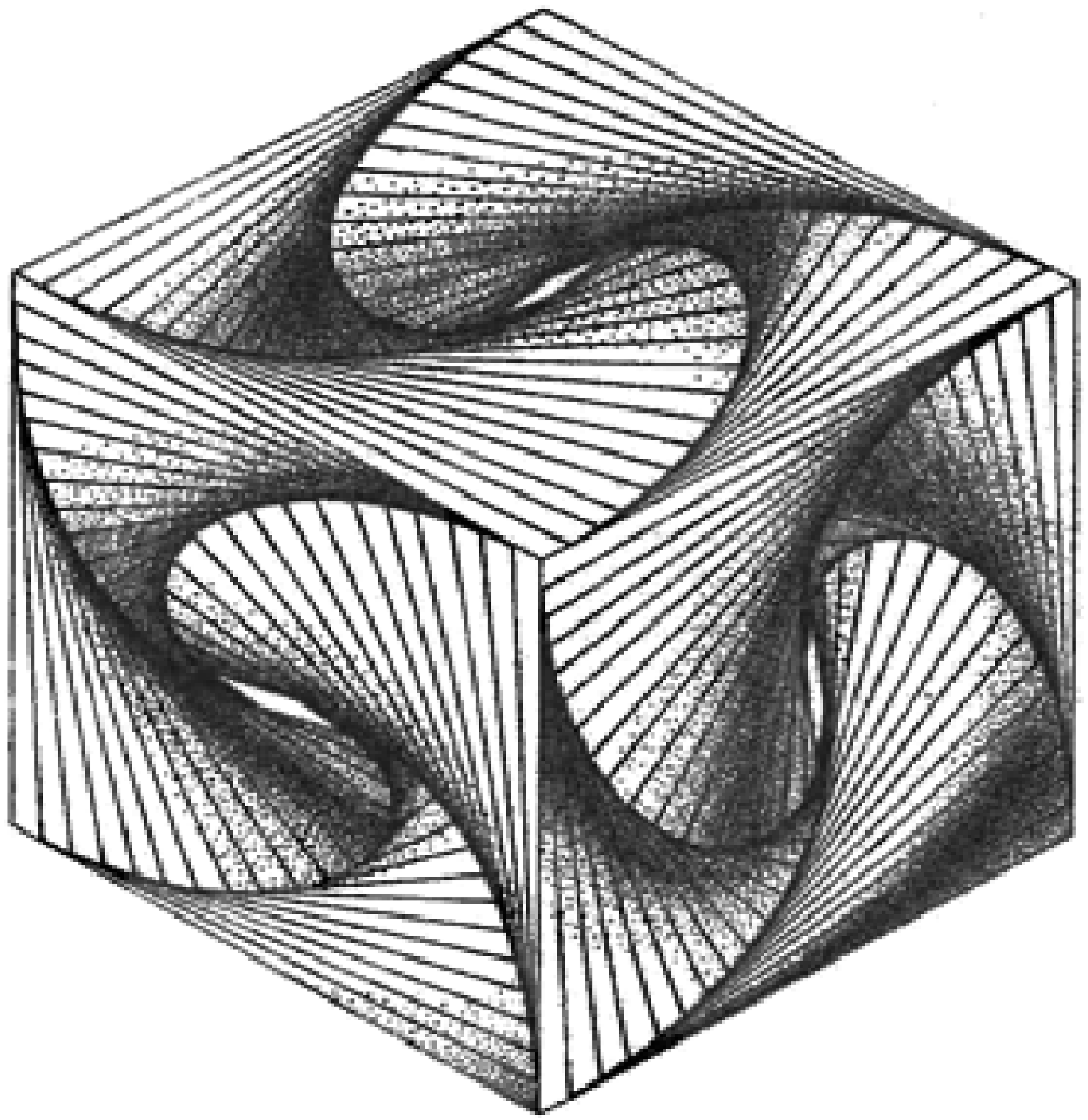
CLUES ↗ UP

6. $\{(x,y,z) : x+3y-z=0,\ x-5y+z=10,\ 2x-y-z=2\}$
7. $\int_0^b \left(x^2+x+\frac{1}{b}\right) dx$.
8. Sum of the natural numbers from 11 to 423 inclusive, plus two for luck!
10. Yes, it is!
12. Two bee to the bee.
13. Number of intersections, and coordinates of intersections, of $y=11-2x$ and $(x-6)^2+(y-9)^2=25$.
14. eeb to the flah eeb ?

E.G.

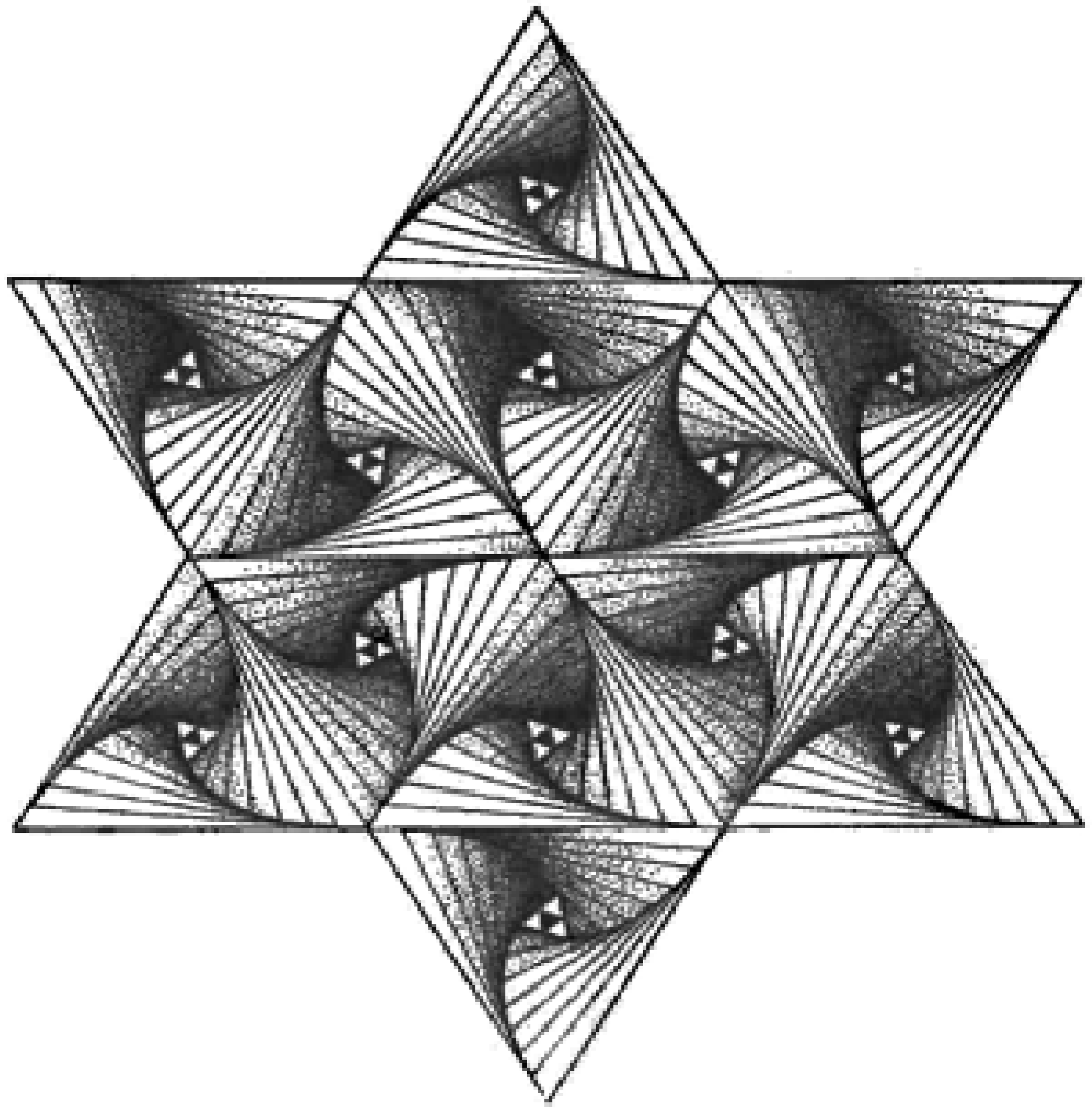


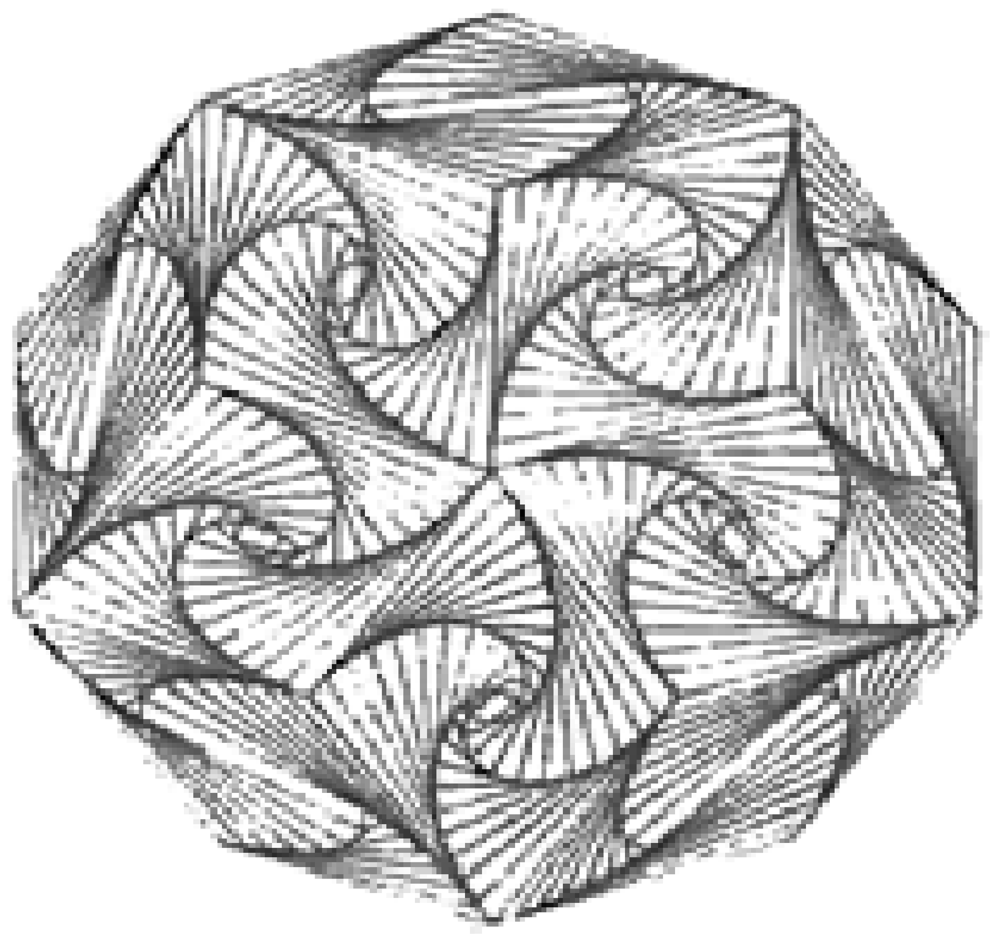


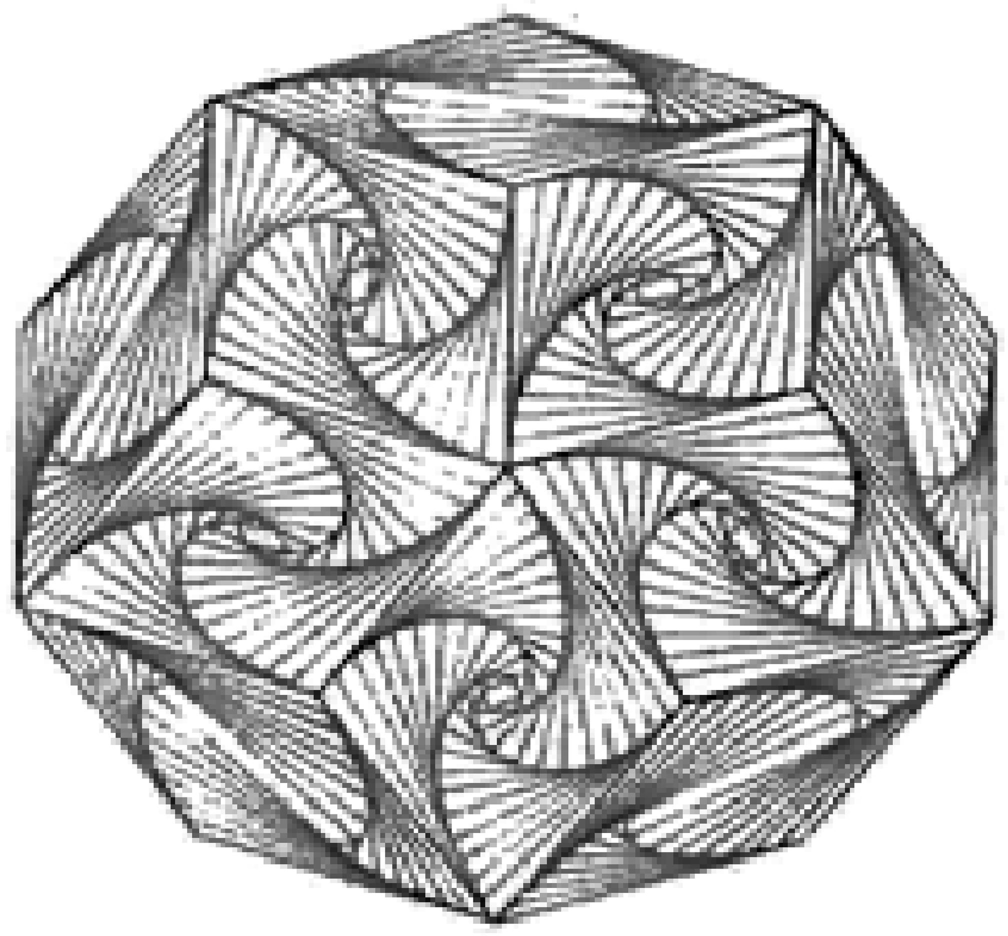


In issue No. 73, Fitted Rhombi explained how a pattern could be formed by fitting rhombi with the same length of side but with varying angles between them. Rings of congruent rhombi were formed in each of the patterns. The centre pages of the last issue showed how curves of pursuit developed in regular polygons by drawing straight lines. An orderly arrangement of equilateral triangles with the pattern inside produced more attractive patterns.

Squares can be used in a similar way but the hexagon leads to problems. Six equilateral triangles or four squares can be arranged at each vertex, in







each case an even number of polygons. The direction of rotation in either case may be the same or may alternate. Three hexagons fitted to each vertex produce a tessellation so the direction of rotation should be the same in each one to produce an attractive pattern.

Curves of pursuit can be fitted into any polygon but they are more attractive when the sides are of equal length. The rhombi which were fitted together in issue No. 73 satisfy these conditions. There are three rhombi at each vertex but the difficulty of the hexagon can be overcome. If each