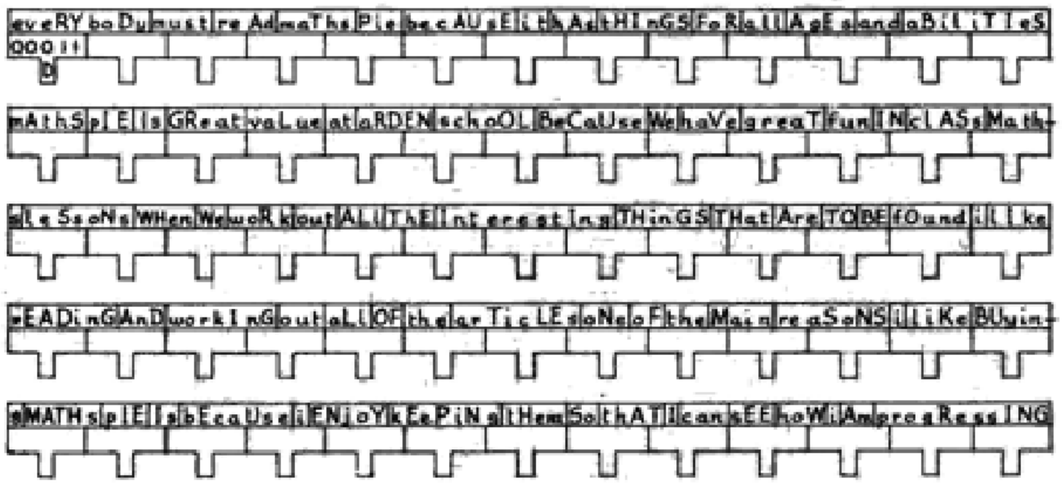
BILATERAL CYPHERS – 2

A way of sending secret messages based on binary numbers was explained in Issue No. 87. Messages can be based on any rule which divides the letters into two distinct subsets. For example we could use a capital letter for 1 and a small letter for 0.

Angela Lees, Arden School, Knowle used this idea to send us this message, for which we thank her and have sent her a book token.

Can you read the message? Ed.



A GOLFER'S WARNING!

A teacher wrote the following number on the blackboard 123 454 638 459 854 321 and asked the class to divide it by 9. After giving time to finish, he called for answers. After getting various ones, the teacher indicated that no-one had the correct answer because there was no fraction in the answer.

He then looked again at the blackboard and realised that a figure had been omitted.

What is the missing figure and where is its position?

R.H.C.

MATHEMATICAL PIE

No. 89 *Editorial Address :* **West View, Fiveways, Nr. Warwick** **SPRING, 1980**

31st March 79.

Dear Sir or Madam.

Each month I purchase one of your mathematical pie magazines, as we sell them in our school. I find it very interesting and my favourite puzzles I copy out onto paper.

I don't really know where you get all your puzzles from, but all the same I would like to contribute to your magazine

GUESS THE NUMBER.

1. Choose a number between one and ten. (E.g. - 6).
2. Then you double it. - (E.g. - 12).
3. Then you add any number which you can half. (E.g. - 10). So, 12 + 10 - 22.
4. When you have done this half your answer. (My answer was 22, so, half of 22 = 11.)
5. And finally you take away the number you first of all thought of. (E.g. - 6). So, - 11 - 6 - 5).

EXPLANATION

As I said in number 3, you can add any number, so long as you are prepared to half it.

Which ever number you decide to choose, your final answer will be always half of this.

(Whilst people are thinking you are mind-readers, what in fact you are really doing is halving your number.)

I hope you will use my puzzle in your super magazine.

Yours Sincerely,
Julian Kellbrick. (12 yrs)

SUM SQUARES (AND A RECTANGLE)

Find a way of arranging a set of 9 squares – with edges measuring 1, 4, 7, 8, 9, 10, 14, 15 and 18 units – into a rectangle.

Squared paper will help, of course!

E.G.

PROBLEM

Here is an interesting one. Find the value of:–

$$(17{\cdot}42 \times 6) \div 5 + 8{\cdot}416 - 107{\cdot}32$$

submitted by C. B. Atkin, Retford.

TRIPLE CHECK?

If 5 people play one game of chess against each other, how many games are there?

How many games would there be for 100 people?

D.I.B.

SUMMITS

123456789	1
12345678	21
1234567	321
123456	4321
12345	54321
1234	654321
123	7654321
12	87654321
+1	+987654321

Make a guess as to which of the two additions gives the larger result.
Test the correctness of your guess.
Can you explain the result?

R.H.C.

THESE YOU HAVE LOVED

Five common errors are shown below:–

$\sqrt{3} + \sqrt{2} = \sqrt{5}$

$x^0 = 0$

$a^2 + a^3 = a^5$

$x^{12} \div x^2 = x^6$

and $\frac{1}{2} + \frac{1}{3} = \frac{2}{5}$

What should the correct statements have been?
Have you any others for us to print in the future?

R.H.C.

SOLUTIONS TO PROBLEMS IN ISSUE No.88

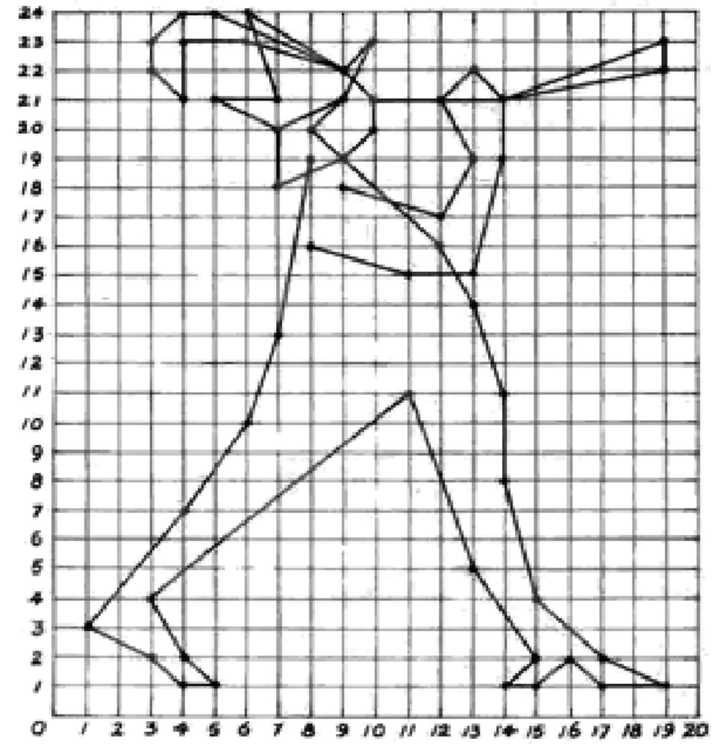
Pythagoras Recalled The shortest piece of string is 60 cm long.

Step It out They covered 60 cm.
In each case we needed the lowest common multiple of 12 and 30.

High Powered The final answer is 9. The number whose square root equals its cube root is 1.

Sticky Paper Flat House Cross-figure
1. 45, 2. 50, 3. 01, 4. 12, 5. 25, 6. 5000, 7. 04, 8. 40, 9. 05, 10. 56, 11. 64, 12. 400.

A Multi-coloured Plot



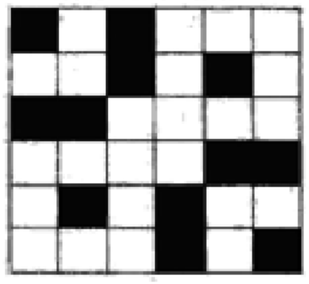
Junior Double Cross

	I		C	C	
S	E	E		A	N
O		A	I	R	
	A	R	C		E
I	S		E	N	D
	H			O	

	I		2	2	
4	3	3		6	5
8		6	I	O	
	6	O	2		3
I	4		3	5	7
	9	3		8	

"ICOSAHEDRON"

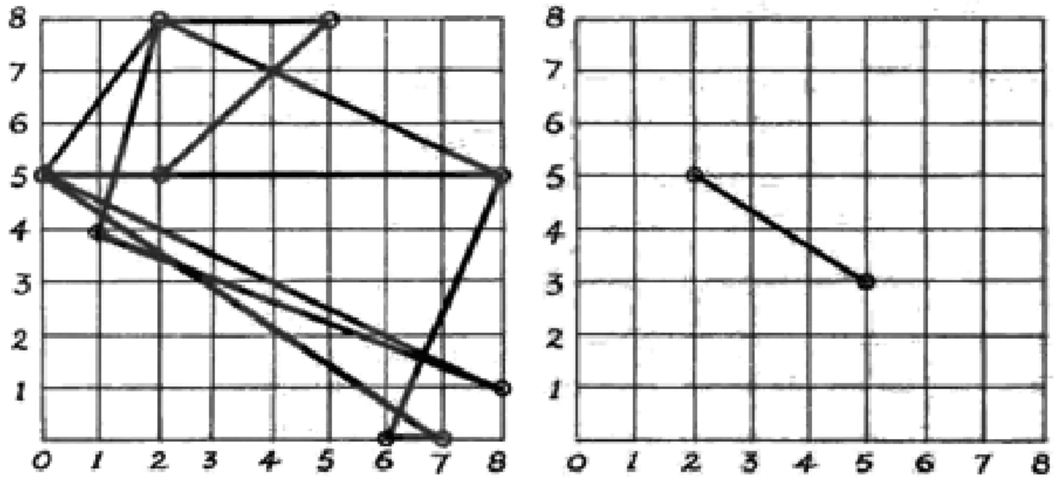
On the Griddle



Time to Spare 1. The numbers 1 to 12
2. Multiples of 5 up to 60
3. The same result as in 2.

B.A.

PICTOCODE No. 4



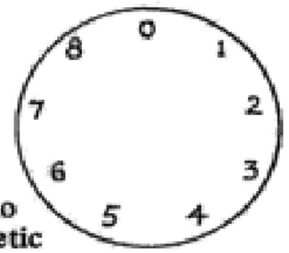
To solve this pictocode, multiply each ordered pair of co-ordinates by the decoding matrix. $\begin{pmatrix} 9 & 4 \\ 2 & 1 \end{pmatrix}$ in modulo 9 arithmetic. Then plot all the transformations, joining them in the order indicated by the straight lines.

For example, starting with the point (0,5):

$$\begin{pmatrix} 9 & 4 \\ 2 & 1 \end{pmatrix} \begin{pmatrix} 0 \\ 5 \end{pmatrix} = \begin{pmatrix} 9 \times 0 + 4 \times 5 \\ 2 \times 0 + 1 \times 5 \end{pmatrix}$$

$$= \begin{pmatrix} 0 + 20 \\ 0 + 5 \end{pmatrix}$$

$$= \begin{pmatrix} 20 \\ 5 \end{pmatrix} = \begin{pmatrix} 2 \\ 5 \end{pmatrix} \text{ in modulo 9 arithmetic}$$



In the same way, the next ordered pair is transformed:

$$\begin{pmatrix} 9 & 4 \\ 2 & 1 \end{pmatrix} \begin{pmatrix} 2 \\ 8 \end{pmatrix} = \begin{pmatrix} 18 + 32 \\ 4 + 8 \end{pmatrix} = \begin{pmatrix} 50 \\ 12 \end{pmatrix} = \begin{pmatrix} 5 \\ 3 \end{pmatrix} \text{ in modulo 9 arithmetic.}$$

D.I.B.

Power To the Romans Cross-figure

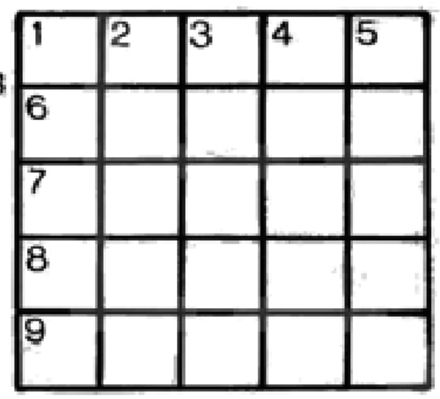
submitted by C. B. Atkin, Retford

Clues Across

1. $2^2 \times 3^2 \times 5 \times 7$
6. $2^2 \times 3^2 \times 5 \times 13$
7. $2^3 \times 7 \times 11$
8. $2^3 \times 3^2$
9. 3^3

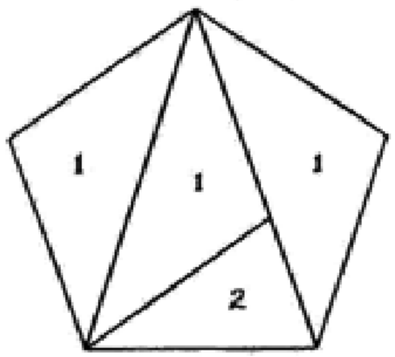
Clues Down

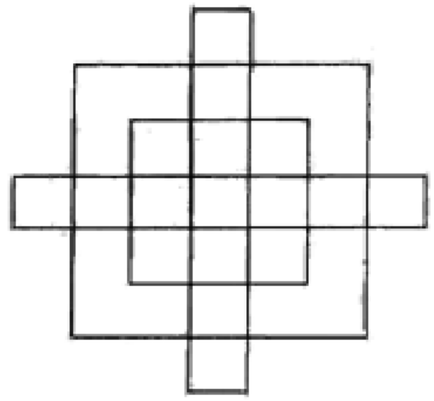
1. $2^9 \times 5$
2. $2^6 \times 5$
3. $5^2 \times 7$
4. $(2^2 \times 17) - 1$
5. $(2^3 \times 3) - 1$



Check. The leading diagonal in the answers is $2^3 \times 139$.

PENT-AGONY!





SQUARE IT

How many squares are shown in the diagram?

The strips are 7 units by 1 unit.

R.H.C.

QUOTE

The idea that aptitude for mathematics is rarer than aptitude for other subjects is merely an illusion which is caused by belated or neglected beginners. *J. F. Herbert (1902)*

Is this still true today? How many adults boast that they cannot read?

Ed.

CUT IT OUT

Cut out two congruent, obtuse-angled, scalene triangles.
Scalene — the three sides are all different.
Obtuse-angled — the angle opposite the largest side is more than 90^o.
Congruent — the same size and shape.

By placing equal sides together, how many different shapes can you make using both triangles?

R.H.C.

LADIES IN MATHEMATICS 1
HYPATIA

Hypatia is the first mathematical lady on record. She was born in Alexandria in Egypt in 370 AD and was the daughter of the mathematician and philosopher, Theon. He must have given her a good education because we are told she soon became abler than her father in both mathematics and philosophy. She became head of the Neoplatonist school in Alexandria and was a popular teacher because she was outstandingly beautiful, modest and intelligent.

We know that she wrote articles on the works of Diophantus, Apollonius and Ptolemy, but sadly all her writings have been lost.

In spite of Hypatia's beauty and intelligence (or perhaps because of it) she had enemies. At that time in Alexandria there were bitter quarrels and even riots between Christians and non-Christians. The Christians saw Hypatia as an enemy because she was teaching science and paganism. She then became involved in a terrible quarrel between two important men of her time — Orestes the Prefect, and Cyril the bishop of Alexandria. Cyril was cruel and ambitious and was determined to get the better of Orestes whenever he could. Orestes was easy going and friendly with Hypatia. It was because of her friendship with Orestes that in 415 AD, at the age of 45, Hypatia was brutally murdered by a party of Cyril's followers. Her pupils left the city after the murder, and she became one of the last teachers of Alexandria. A.M.A.

TRIANGLES PUZZLE

Carefully draw a set of equilateral triangles (a dozen or so will do to get you started, but you will need more later).

On each triangle, draw the three lines from the centre to the vertices (the centre is two-thirds of the way down a line of symmetry from the vertex) see fig.1.

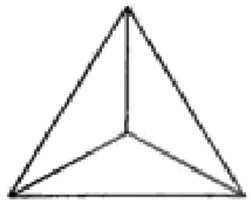


fig.1

We will now colour the three isosceles triangles of each diagram, and see how many different patterns we can make if we have FOUR colours available – let's say red, white, blue and yellow. A particular colour may be used more than once – even three times – on one diagram, or might not be used at all. Of course, patterns which are rotations of each other are not really different, but mirror-images are allowed, see fig. 2.

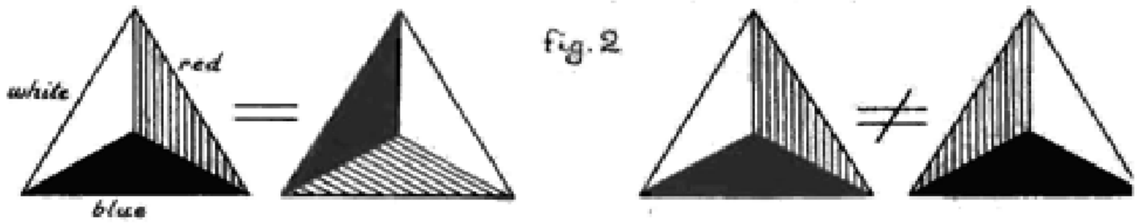


fig.2

This is where you run out of triangles and will need to draw some more. You should be able to find twenty-four different patterns. Cut them out and check that they really are all different, just in case you have got two the same and have missed one of the others.

NOW – can you find a way of placing the twenty-four triangles edge to edge in a parallelogram (as shown in fig.3), keeping all the outside edges white and matching the colour of edges which are next to each other? There are many different solutions – the figure shows part of one of them. E.G.

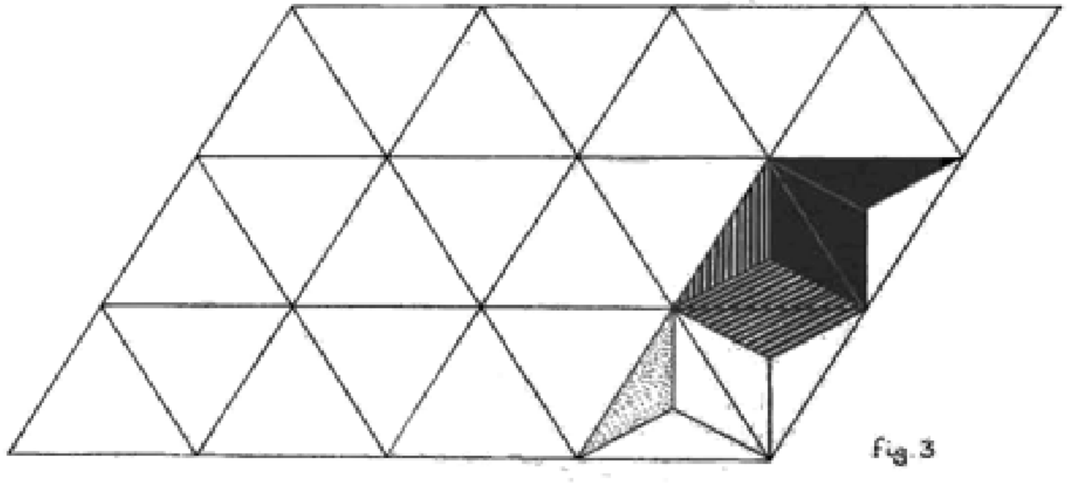


fig.3

SOLD

A man sold a bicycle for £50. He bought it back again for £45 and then sold it again for £65.

What was his overall gain? R.H.C.

TRUANT OR HERE?

The famous St. Truant's Public School is built in the form of a square, divided into eight rooms with a quadrangle in the middle.

After the Maths lessons, period 1, the Maths Teacher had a harrowing experience because he was asked to find out if anyone was playing truant. In each of the rooms, there should have been three pupils. For period 2, the check revealed that all were present with 3 boys in each room, i.e. 9 boys in each row of classrooms.

During period 3, 4 boys played truant but the Maths Teachers found 9 boys in each row. During period 4, the 4 truants came back accompanied by 4 friends and the Maths Teacher still found 9 boys per row.

Four more friends came in for the next lesson but there were still 9 boys per row and so the wise man came to the conclusion that their suspicions were unfounded.

Draw diagrams to illustrate how the Maths Teacher was deceived.

R.H.C.

A LOGICAL SOLUTION

If each letter corresponds to its respective position in the alphabet, with A = 1, B = 2, etc. find a five-letter word such that:–

(a) the sum of the third and fourth letters is 16 and their product is 63;
(b) the fifth is the square root of the fourth;
(c) the difference between the first and second letters is equal to the fifth and their sum is equal to the product of the fourth and fifth letters.

D.I.B.

PENT-AGONY!

Can you find a way of cutting a regular pentagon into FOUR isosceles triangles? (Try it first, but if you get really stuck the answer is on page 706 so that you can go on to the next part).

Draw two equal regular pentagons and cut them up into the triangles. Using all eight pieces placed edge to edge, try to make:–

(a) a single pentagon, (b) a hexagon with one line of symmetry, (c) a hexagon with two lines of symmetry, (d) a parallelogram.

E.G.

SQUARING THE CIRCLE

Olivier de Serres (1539) was one of the many who have tried to "Square the circle", i.e. construct a square equal in area to a circle using a ruler and compasses only.

He found by weighing that the area of a circle is very nearly equal to that of a square drawn on the side of an inscribed equilateral triangle. If the radius of the circle is taken to be 1 unit of length, the area of the circle is π square units.

What value of π does this approximation give? R.H.C.