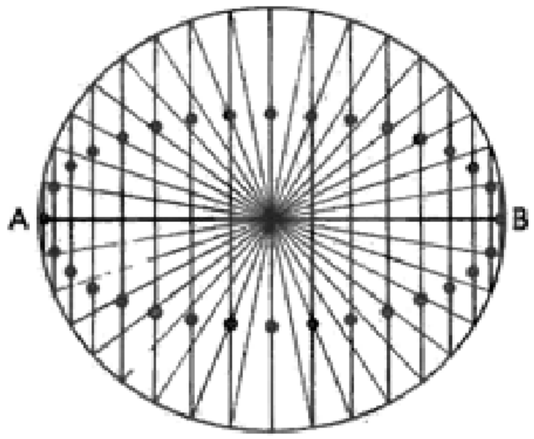
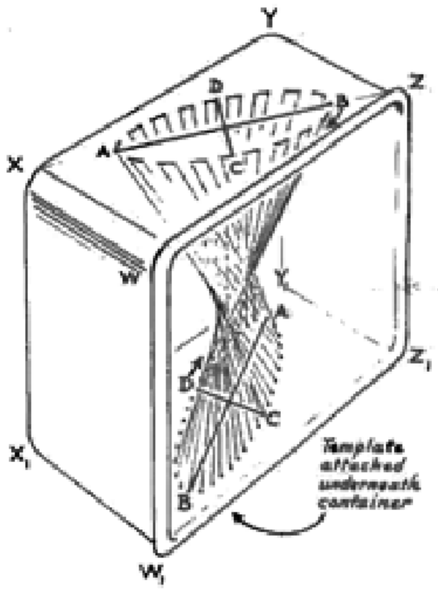
THREE DIMENSIONAL CURVE STITCHING

The two-litre plastic containers in which ice cream is sold and a reel of coloured shiny elastic thread provide inexpensive and easily obtainable materials for the attractive art of three-dimensional curve-stitching.



For this example, a container of depth 95 mm is used, but the actual dimensions are not critical. On a piece of paper, a circle is drawn with the diameter AB = 100 mm. (See figure 1). Using a protractor, the circumference is divided into 36 equal parts, starting at A or B. From each of these points on the circumference, perpendiculars are drawn to the diameter and the mid-points of these lines are marked to give a set of points on an ellipse.

The paper template is then trimmed to a convenient size and positioned so that the major axis, AB, of the ellipse lies along a diagonal, XZ, of one face of the open container. (See figure 2). It is held in place with a strip of self adhesive tape and holes for the ellipse are pushed through the plastic using the point of a pair of compasses.



The template is then removed and attached to the opposite face of the container, but with the major axis lying along the diagonal W_1Y_1. Holes are pushed through the plastic as before.

Taking a working length of about 2 m of the thread in a needle, it is sewn from B to D, then into the hole adjacent to D (in the direction of the arrow) and back into the hole adjacent to B (again in the direction of the arrow), and so on, progressing one hole at a time. Further lengths of the thread can be tied to the lengths that have been used (outside the container) when required.

As the model develops, care will be needed to ensure that the threads are correctly interwoven to maintain a straight line between each pair of holes at the top and the bottom of the container.

By varying the figures marked on the top and the bottom of the container, a number of different models can be stitched. Coloured paper as a background and the inclusion of a battery and bulb could result in a worthwhile mathematical decoration.

D.I.B.

MATHEMATICAL PIE

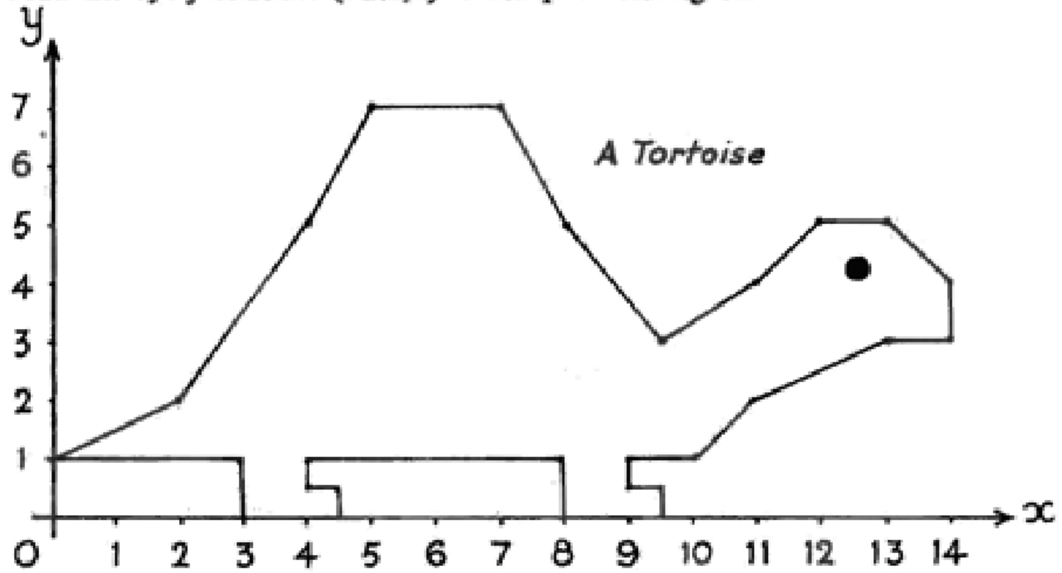
No. 87 — *Editorial Address :* West View, Fiveways, Nr. Warwick — SUMMER, 1979

TRANSFORMATION

submitted by Jenny Stark, aged 13, St. Albans Girls' School

Plot the following co-ordinates to draw a tortoise.

Start at (0,1) and join to (2,2) and one to (4,5), (5,7),(7,7), (8,5), (9½,3), (11,4), (12,5), (13,5), (14,4), (14,3), (13,3), (11,2), (10,1), (9,1), (9,½), (9½,½), (9½,0), (8,0), (8,1), (4,1), (4,½), (4½,0), (3,0), (3,1), (0,1), Draw the eye just above (12½,4) to complete the figure.



Now transform the tortoise by doubling the x-co-ordinate and halving the y-co-ordinate.

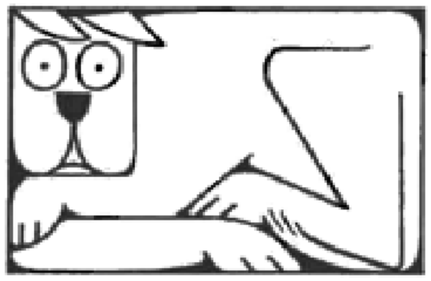
SYMPATHETIC NUMBERS

If you add and also multiply the two numbers 2 and 47, the results are 49 and 94 which contain the same two digits.

Can you find another pair of different numbers with the same property? Can you find a single number which when added to itself and when multiplied by itself has this property?

R.H.C.

DENNIS THE MENACE



The members of the Editorial Board often now enter board meetings in fear and trembling as the editor's dog Dennis doubles in size each term.

The last meeting was held in the hallway because Dennis, now two years old filled the meeting room. How old was he when he half filled the room? A.M.A.

CAPTAIN AHAB AND THE GREAT WHITE ANT

Let x = weight of whale and
y = weight of an ant.

Let $x + y = 2v$, so that
$x - 2v = -y$ .....(1)
and $x = -y + 2v$ ...(2)

Multiplying the two equations
$(x - 2v)\ x = -y\ (-y + 2v)$
$x^2 - 2vx = y^2 - 2vy$

Adding v^2 to each side
which gives $x^2 - 2vx + v^2 = y^2 - 2vy + v2$
and so $(x - v)^2 = (y - v)^2$
or $x - v = y - v$
$x = y$

The weight of an ant is equal to the weight of a whale. R.H.C.

MONEY FOR OLD ROPE

Your Post Office Savings account contains £10, on each of two occasions.

Episode One		Episode Two	
Withdraw £4 leaving £6		Withdraw £5 leaving £5	
Withdraw £3 leaving £3		Withdraw £2 leaving £3	
Withdraw £2 leaving £1		Withdraw £2 leaving £1	
Withdraw £1 leaving £0		Withdraw £1 leaving £0	
Adding	£10 £10		£10 £9

Why is there this discrepancy? Which arrangement of withdrawals will produce the greatest discrepancy? R.H.C.

SOLUTIONS TO PROBLEMS IN ISSUE No. 85

No deal! The largest amount of change that will not enable you to change a 50p piece is 55½p, made up of 4 x 10p, 1 x 5p, 4 x 2p and 1 x 2½p. When the 2½p piece is withdrawn, 1 x ½p can replace it to give a total of 53½p.

Pentagons and triangles. There are 35 triangles in sets of 5 congruent to AEH, AEB, AHJ, ADC and AGC and 10 congruent to AEJ.

The pint that thinks its a quart. The volume of the glass is one gallon. The ratio of the areas of the bases is 4:1.

Diagonals. The number of squares that are cut by by the diagonal is (w+1—1).

Use your judgement. (c) is correct — refer to Theorem in stitches is No.85.

SOLUTIONS TO PROBLEMS IN ISSUE No. 86

Back to front. 23 x 64 = 46 x 32 = 1472.

How odd! The number is 1 014 492 753 623 188 405 797.

Fits. All quadrilaterals and all triangles will cover a plane surface. The arrangement is called a tessallation.

Vocabulary. The numbers are 170 and 70. The sum is therefore 240.

BODMAS Without brackets, the answer is 20½. Using one pair of brackets, answers of 22½, 23, 26½ and 29 can be obtained.

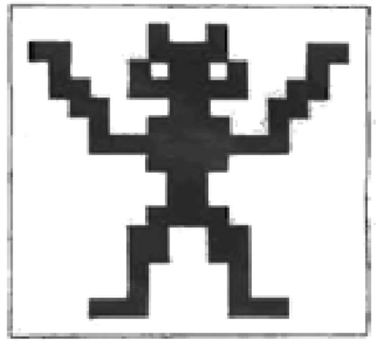
This and that. The ratio is 5:4.

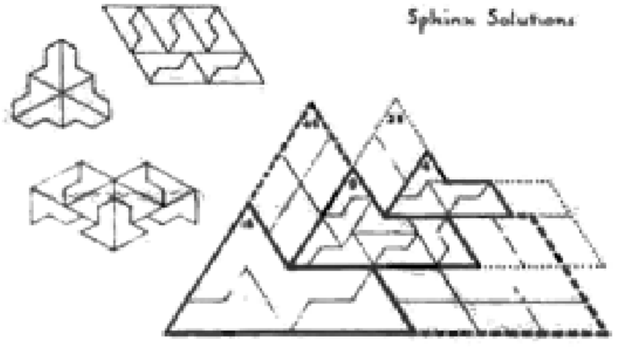
How strange! If the first tens figure is a and the first units figure is b, then the numbers are 10a+b and 10a+(10—b). Using simple algebra it can be shown that the product is equal to the product of 10a and 10(a+1) added to the product of b and (10—b), which are the numbers in the second expressions.

Overtaking problems. The time taken by the car to overtake the juggernaut is a little over 10 seconds during which time it has travelled over 220 metres.

B.A.

Contact!





THE HOBBIT PROBLEM

Read through *The Hobbit* by J. R. R. Tolkien and find the numbers involved in the twelve incidents below. Multiply your numbers together.

1. Number of dwarfs who began the journey.
2. How many trolls did they meet?
3. For how many days did the travellers stay in Riverdell?
4. How many riddles were asked in the meeting with Gollum?
5. Number of days spent in the Misty Mountains with the goblins.
6. Number of white horses in Beorn's house?
7. How many days did it take to cross the Long Lake?
8. How many feet was the secret door above the valley?
9. Area of the secret door in square feet.
10. How many hours was the march from the Front Door of the Mountain to the Look-out Tower?
11. How many armies took part in the final battle?
12. The number of dwarfs who survived the final battle.

B.A.

How to win a three-legged race using equations

1 man has o tails
x cats have x tails

multiplying, 1 manx cat has 0 tail

E.G.

COVER UP!

A parallelogram is placed on top of a square as in figure 1. Find the combined areas of the two shapes.

Two right-angled triangles are placed one on top of the other as in figure 2. Find the combined areas of the two triangles. What do you notice about the two results? Which calculation was the easier?

A.M.A.

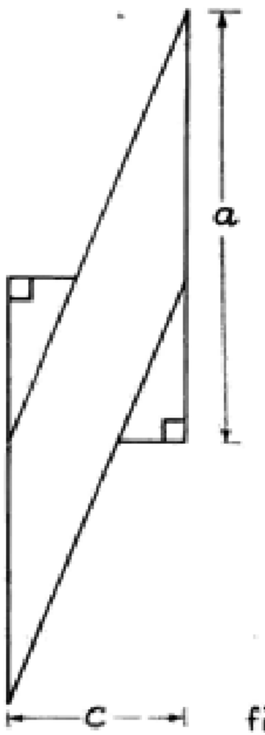


fig.1

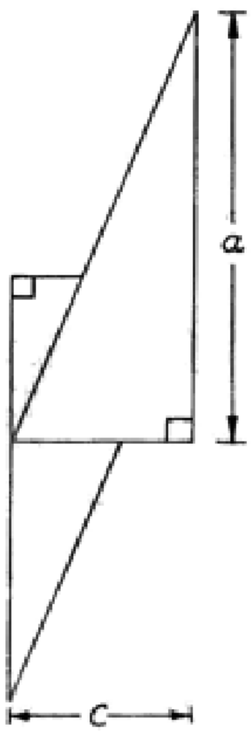


fig.2

PI FILLING

For this quick calculating trick, you need a piece of tracing paper. Carefully trace the π outline from figure 1 and then you are ready to amaze your friends.

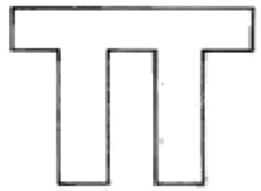


fig.1

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

fig.2

Place the tracing paper anywhere over the number square, figure 2, so that the π is upright and encloses eleven squares of numbers. Challenge a friend to find the total of the eleven numbers. To their surprise, you will have written down the answer long before they get it!

Here is the secret: all you need to do is an easy calculation with the two numbers near the centre of the pattern. For example:–

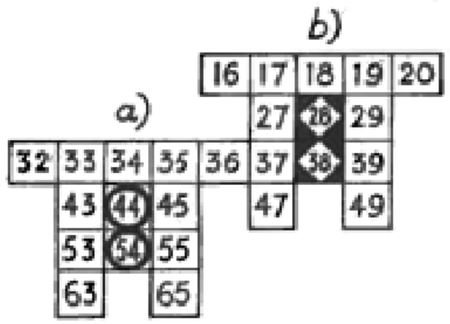


fig.3

In figure 3(a), while your friend is struggling with 32 + 33 + 34 + 35 + 36 + 43 + 45 + 53 + 55 + 63 + 66, all you do is

440
+54
Answer 494

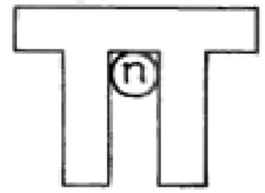


fig.4

In figure 3(b), the quick way is to add 280 and 38 to get 318. If you are quick at multiplying by ten and adding, you should be able to beat your friends even if you have an electronic calculator! Readers who know a little algebra might like to try to prove that if we call the number near the centre n (as in figure 4) the total of the numbers within the π shape is $10n + (n+10)$.

E.G.

JUST ONE QUESTION

Lieutenant Columbo was interviewing three suspects after a robbery. He knew that it was a one-man job and that each of the suspects told him a lie and each made a truthful statement.

Lenny the leg said: "It wasn't me – and Eric the ferret didn't do it"
Eric the ferret said: "It wasn't me – and it wasn't Fingers Freddie"
Fingers Freddie said: "I didn't do it – and the other two were at home with me watching television"

The Lieutenant immediately knew who was the culprit and arrested him. Who was it?

A.M.A.

O	O	O	O	O	A
O	O	O	O	I	B
O	O	O	I	O	C
O	O	O	I	I	D
O	O	I	O	O	E
O	O	I	O	I	F
O	O	I	I	O	G
O	O	I	I	I	H
O	I	O	O	O	I
O	I	O	O	I	J
O	I	O	I	O	K
O	I	O	I	I	L
O	I	I	O	O	M
O	I	I	O	I	N
O	I	I	I	O	O
O	I	I	I	I	P
I	O	O	O	O	Q
I	O	O	O	I	R
I	O	O	I	O	S
I	O	O	I	I	T
I	O	I	O	O	U
I	O	I	O	I	V
I	O	I	I	O	W
I	O	I	I	I	X
I	I	O	O	O	Y
I	I	O	O	I	Z

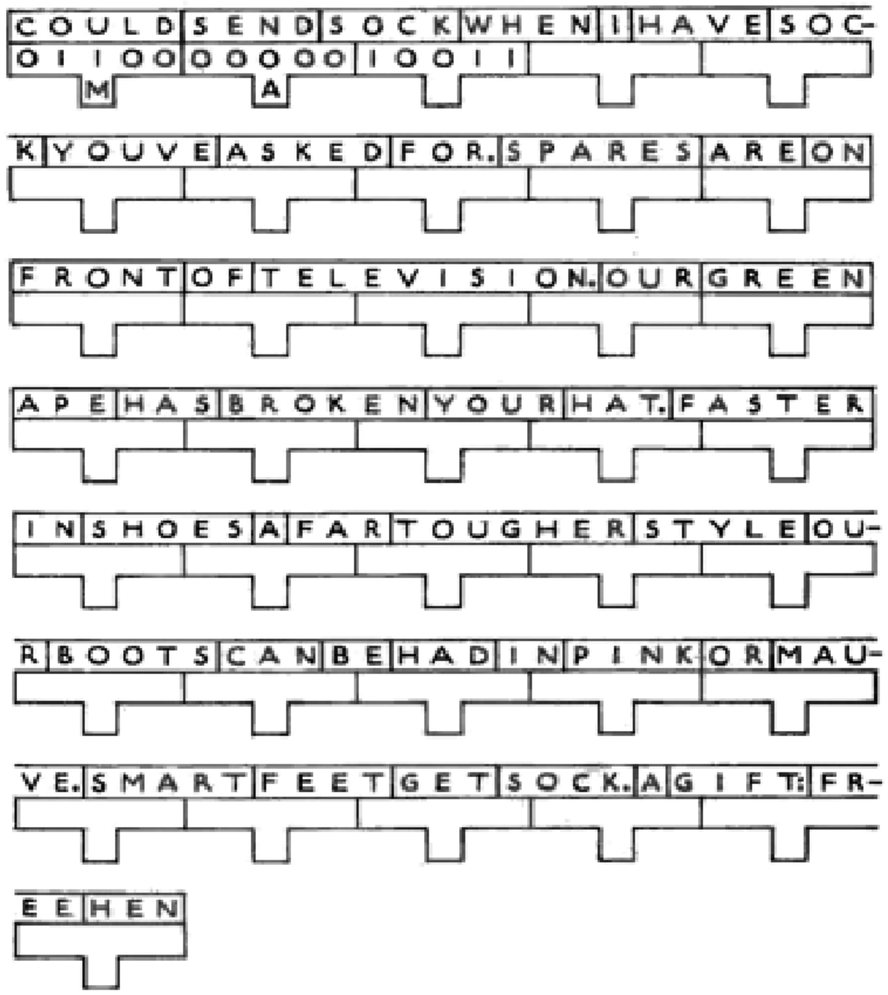
BILATERAL CYPHERS

Here is a way of sending secret messages which is different from the letter-for-letter or number-for-letter codes. It is based on binary numbers (as shown on the left).

Messages can be based on any rule which will divide the letters into two distinct subsets. For example we could use vowels and consonents, or capital letters and small letters. If a capital letter stood for 1 and a small letter stood for 0, the "message" "mATHS ple is grEAT" would really mean 01111,01000,00110 = PIG.

You see that a message in the cypher has five times as many letters as its meaning. Opposite is a "telegram" from a shop-keeper who stocks socks, but I think he's a pie spy. Letters with vertical symmetry stand for 1 and letters without vertical symmetry stand for 0. The decyphering has been started for you.

E.G.



IN DAYS OF OLD

In the olden days, mathematicians were taught multiplication tables only as far as 5 x 5, so that a written method had to be used when they wanted to multiply numbers such as 7 and 8. Robert Recorde (1510 – 1558) gives a method as follows:–

7		3
	subtract each from 10	
8		2

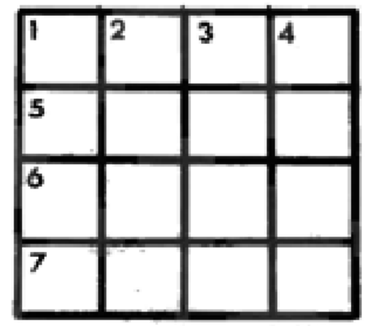
The units digit is found by multiplying together these two remainders, 3 x 2 = 6, whilst the tens figure of the product is found by subtracting diagonally either way, (7 – 2), or (8 – 3) = 5. The answer is 56. Now try 9 x 6.

Experienced mathematicians might try to justify the method.

R.H.C.

JUNIOR CROSS FIGURE No. 69

24 hour clock cross-figure



Clues Across

1. 22 minutes past one a.m.
2. half past eight in the evening
6. six minutes to 3 p.m.
7. one minute before 7 p.m.

Clues Down

1. 11 minutes past 2 a.m.
2. 12 minutes before 11 a.m.
3. 5 minutes before midnight
4. 11 minutes before 9 p.m.

A.M.A.