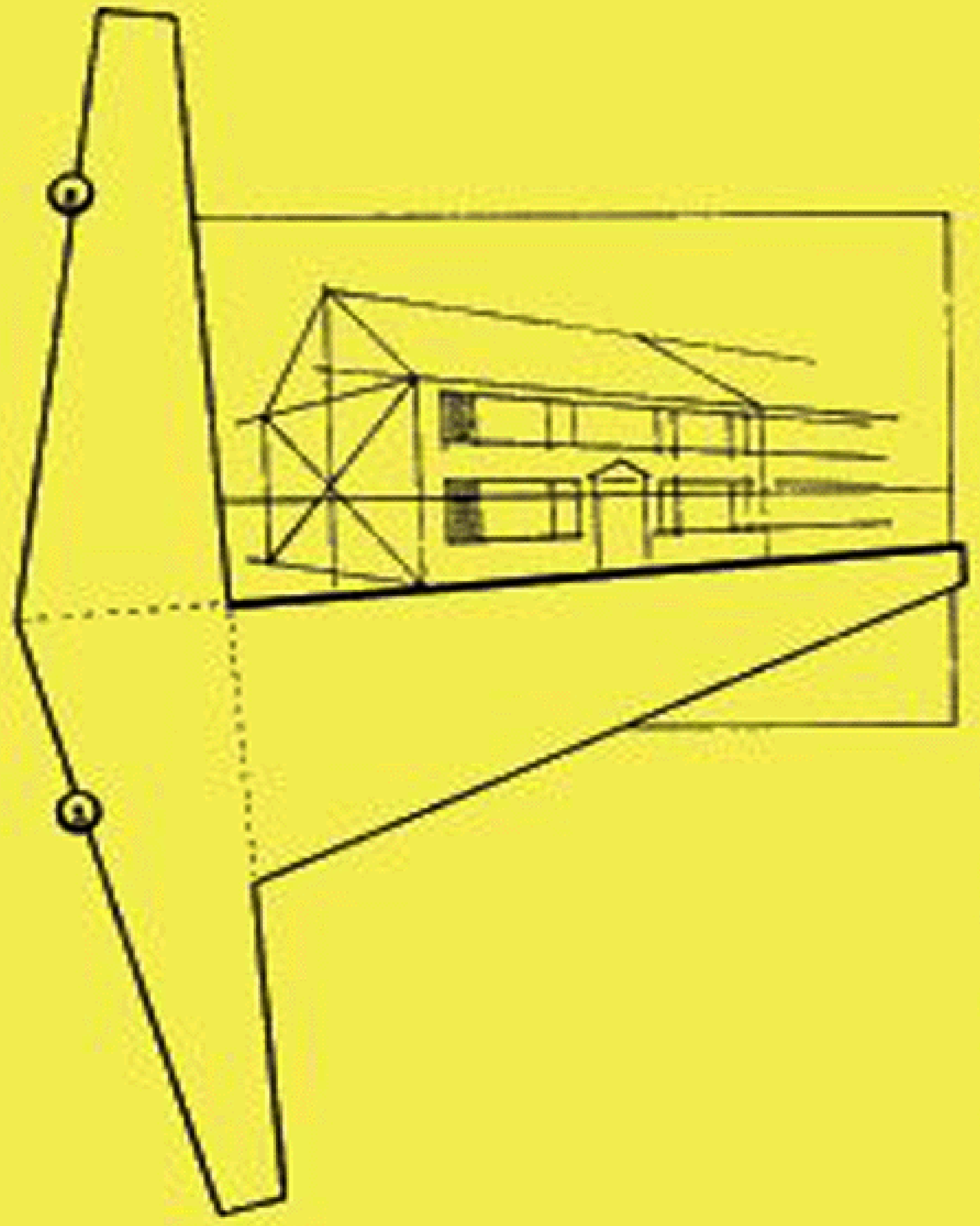
TO THE POINT

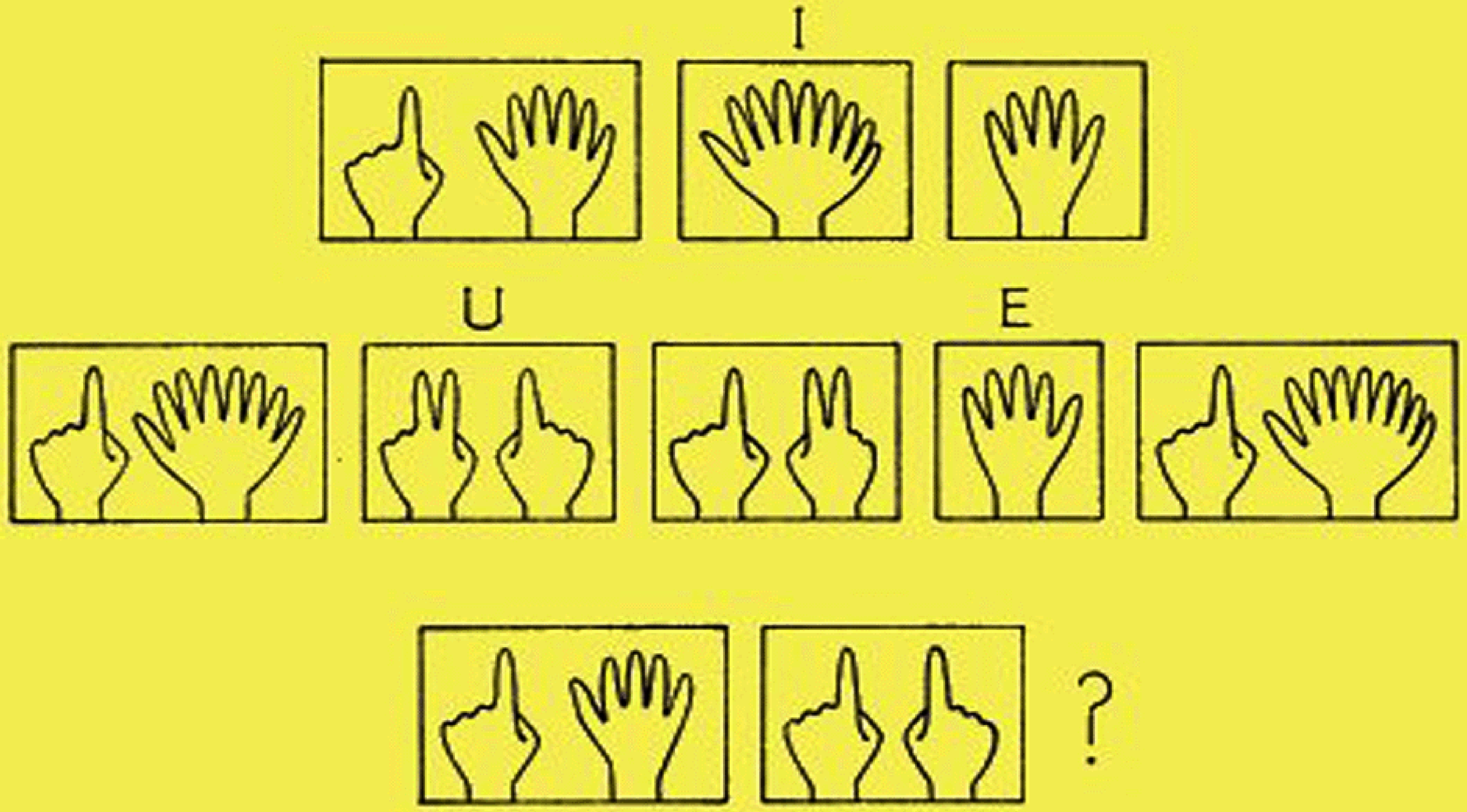


In a correct perspective drawing, lines which are parallel are represented by lines meeting at a point. Unfortunately, the point is often off the drawing paper. Hardboard can be used to make a simple gadget, rather like a T-square, so that lines can be drawn meeting at a point off the paper. Instead of a straight cross piece the perspective square has a very blunt triangle. The line of the ruler edge would bisect the angle. To use the perspective square, the sides of the angle slide against two drawing pins fixed at the side of the drawing board.

Why does it work?

C.V.G.

A HANDSOME MESSAGE



Can you decode the message above? Some of the letters are given as clues to help you.

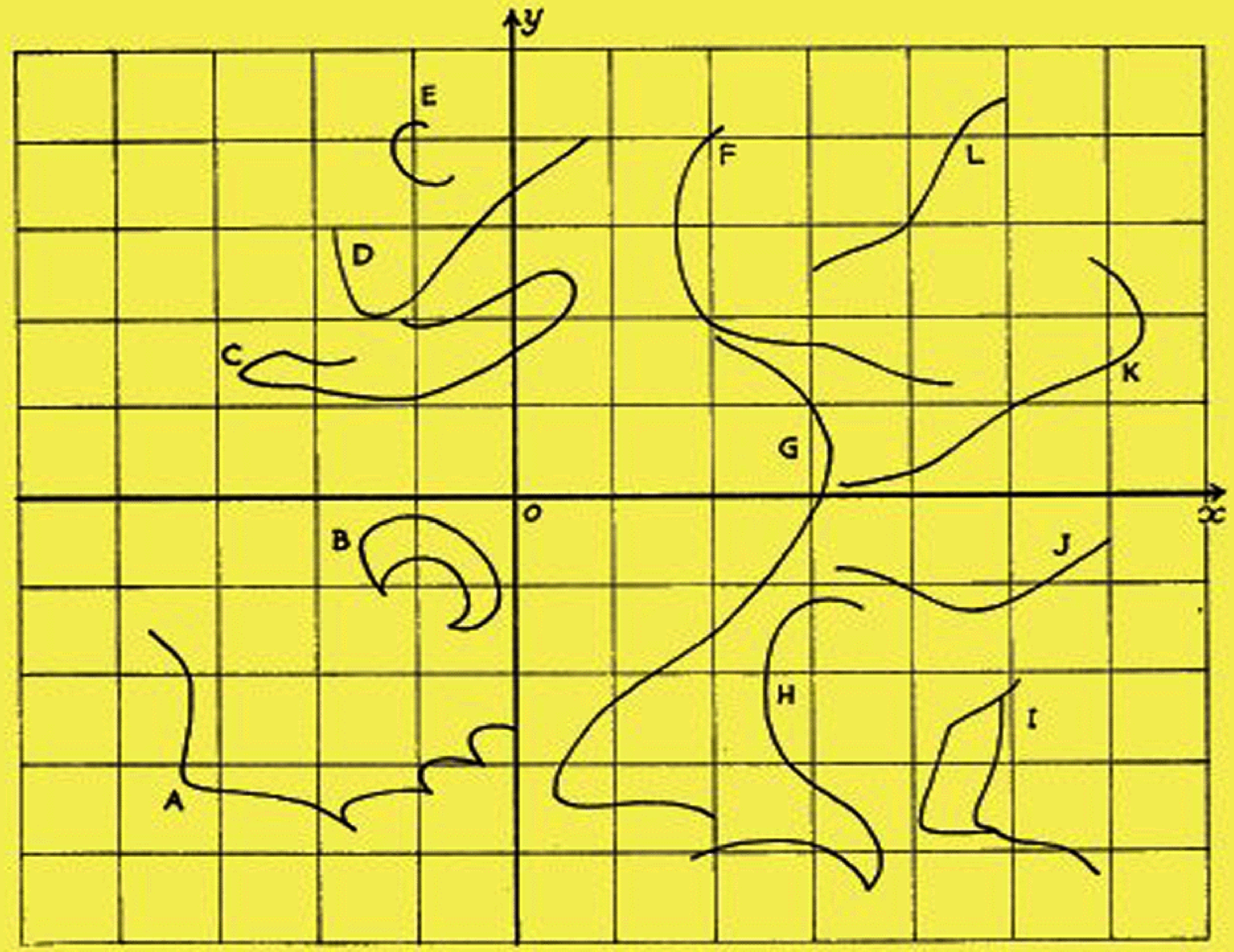
A.M.A.

Printed by Ratnett & Co. Ltd.,
Knighton Junction Lane, Leicester

join the mathematical pie / in mathematical pie / smathematical pie / mathematical pie

No. 80 | *Editorial Address :* West View, Fiveways, Nr. Warwick | SPRING, 1977

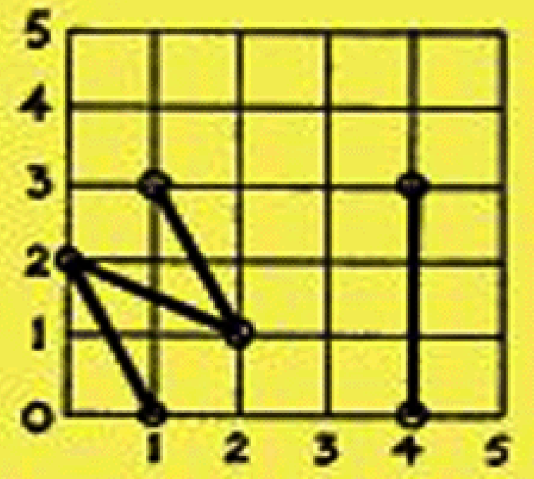
SCRAMBLE AGAIN



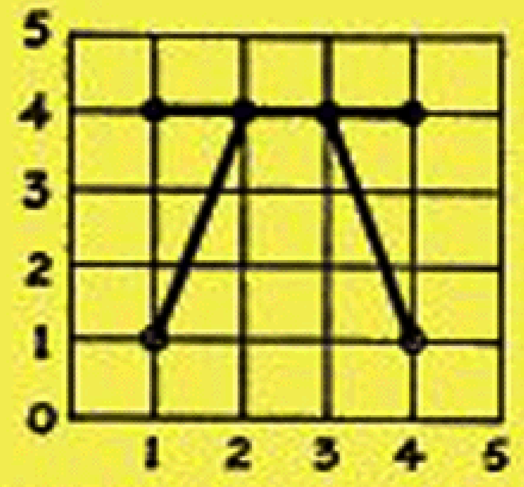
To unscramble the drawing above, you will need a piece of tracing paper large enough to cover the rectangle. Draw round the rectangle and mark a point on your tracing paper where 0 is on the diagram. The list below gives the position to which your tracing paper should be moved before you trace each lettered curve. The x—and y— axes are marked on the diagram. For example, the point 0 should be moved to the point (—2, 1) before tracing the curve A. Make sure that the edges of your tracing paper rectangle are properly horizontal and vertical after each move. A (—2, 1); B (—2, —4); C (—3, —1); D (2, 3); E (—2, 1); F (6, 4); G (0, 0); H (3, —5); I (5, 0); J (3, —3); K (5, 2); L (6, 4).

E.G.

PICTOCODES



Pictocode (fig. i)



Decoded Picture (fig. ii)

Plotted in order, the following sets of points represent the coded picture, or "pictocode", shown in fig. i:

$$\left\{\begin{pmatrix}4\\3\end{pmatrix},\begin{pmatrix}4\\0\end{pmatrix}\right\},\ \left\{\begin{pmatrix}1\\0\end{pmatrix},\begin{pmatrix}0\\2\end{pmatrix},\begin{pmatrix}2\\1\end{pmatrix},\begin{pmatrix}1\\3\end{pmatrix}\right\}$$

When each ordered pair is multiplied by the decoding matrix $\begin{pmatrix}1&1\\1&2\end{pmatrix}$ in Mod. 6 arithmetic, the new points plotted in order reveal the familiar decoded picture shown in fig. ii.

Applying the usual rules for matrix multiplication:

$$\begin{pmatrix}a&b\\c&d\end{pmatrix}\begin{pmatrix}x\\y\end{pmatrix}=\begin{pmatrix}ax+by\\cx+dy\end{pmatrix}.$$

In this way,

$$\begin{pmatrix}1&1\\1&2\end{pmatrix}\begin{pmatrix}4\\3\end{pmatrix}=\begin{pmatrix}4+3\\4+6\end{pmatrix}=\begin{pmatrix}1\\4\end{pmatrix}\text{in Mod. 6}$$

Similarly,

$$\begin{pmatrix}1&1\\1&2\end{pmatrix}\begin{pmatrix}4\\0\end{pmatrix}=\begin{pmatrix}4\\4\end{pmatrix}\text{ in Mod. 6}$$

Thus, the first set of points is transformed into:

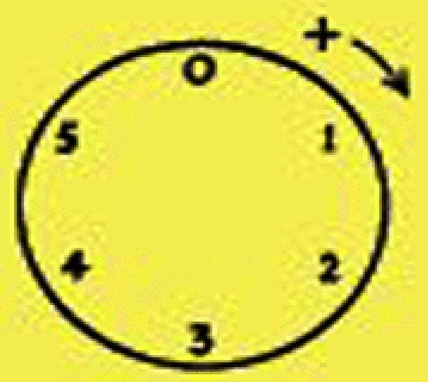
$$\left\{\begin{pmatrix}1\\4\end{pmatrix},\begin{pmatrix}4\\4\end{pmatrix}\right\}$$

Further multiplication transforms the second set into:

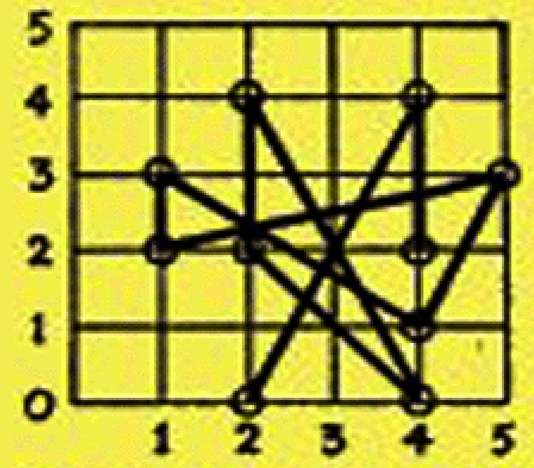
$$\left\{\begin{pmatrix}1\\1\end{pmatrix},\begin{pmatrix}2\\4\end{pmatrix},\begin{pmatrix}3\\4\end{pmatrix},\begin{pmatrix}4\\1\end{pmatrix}\right\}$$

By using the decoding matrix $\begin{pmatrix}5&2\\2&1\end{pmatrix}$ in Mod. 6, decode the "top secret" blue-print shown below.

D.I.B.



Mod. 6 Clock



Pictocode Blue-print

NOUGHT

There once was a number named zero
Who tried to divide and got stuck
When he tried to add on he just couldn't,
Rotten stinking luck.

When he multiplied everything vanished
No number was that number's friend
So one day he rolled up in a circle
Turned over and joined up the end.

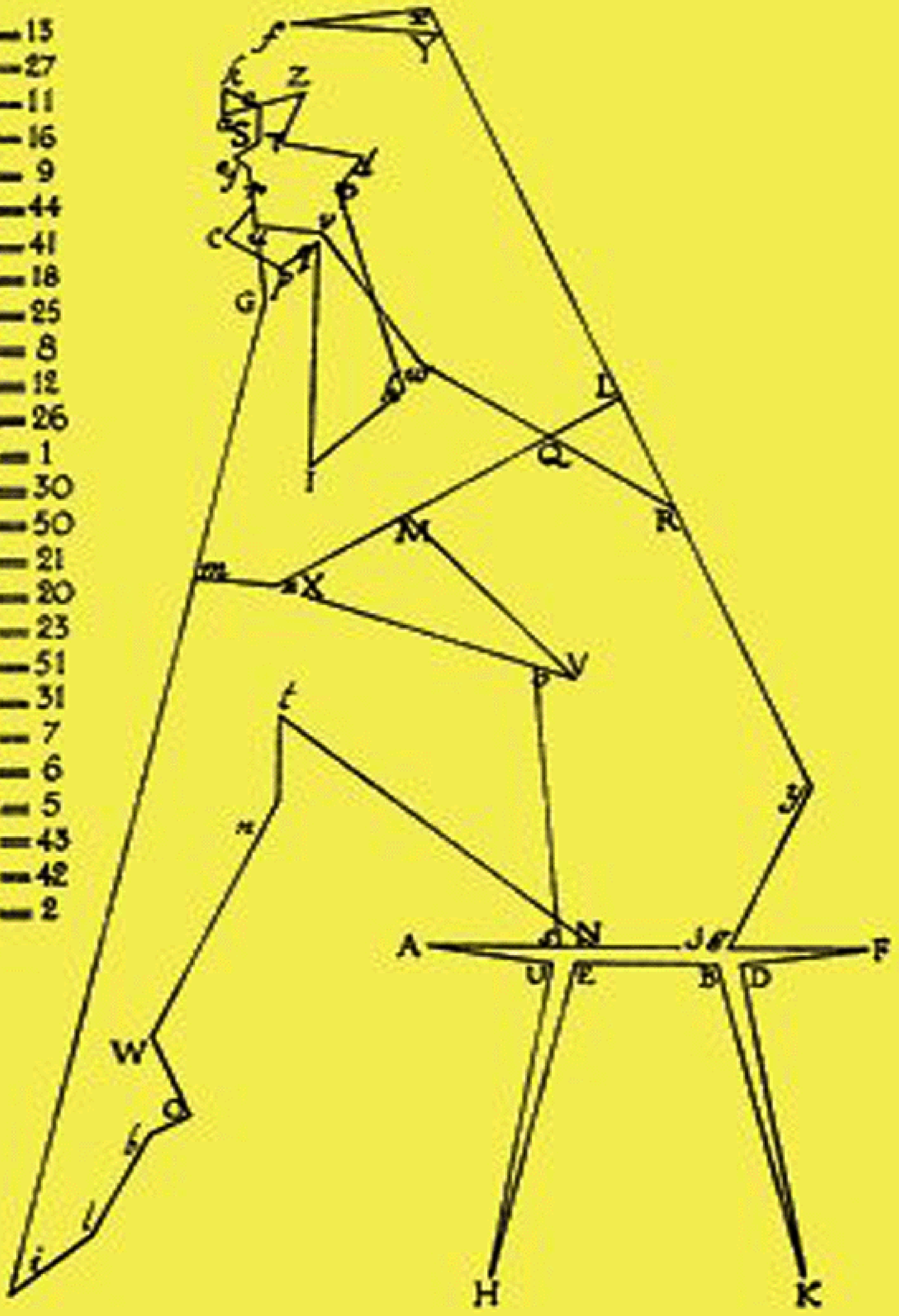
Now he rolls about spreading discomfort
Dividing by him is a pain
And adding him on makes no difference
Though you do it again and again.

Whoever invented this number
Must be laughing his head off at us,
Because adding it on makes no difference
But multiplying does.

A.M.A.

AN ATTRACTIVE PLOT

A—33	a—13
B—37	b—27
C—22	c—11
D—39	d—16
E—36	e—9
F—40	f—44
G—24	g—41
H—35	h—18
I—19	i—25
J—52	j—8
K—38	k—12
L—46	l—26
M—47	m—1
N—32	n—30
O—28	o—50
P—17	p—21
Q—3	q—20
R—4	r—23
S—10	s—51
T—15	t—31
U—34	u—7
V—48	v—6
W—29	w—5
X—49	x—43
Y—45	y—42
Z—14	z—2



GOING METRIC

96·5 cm. is approximately 38 inches. Bunny is 96·5, 67, 96·5 and Cutie is 91, 61, 91 cm.

FAMOUS NAMES

6 should have read OIL GALE giving Galileo, 1 was Recorde, 2 Pythagoras, 3 Eratosthenes, 4 Copernicus, 5 Plato and 7 was Lobachevsky giving in the circles our old friend CHARLIE COOK.

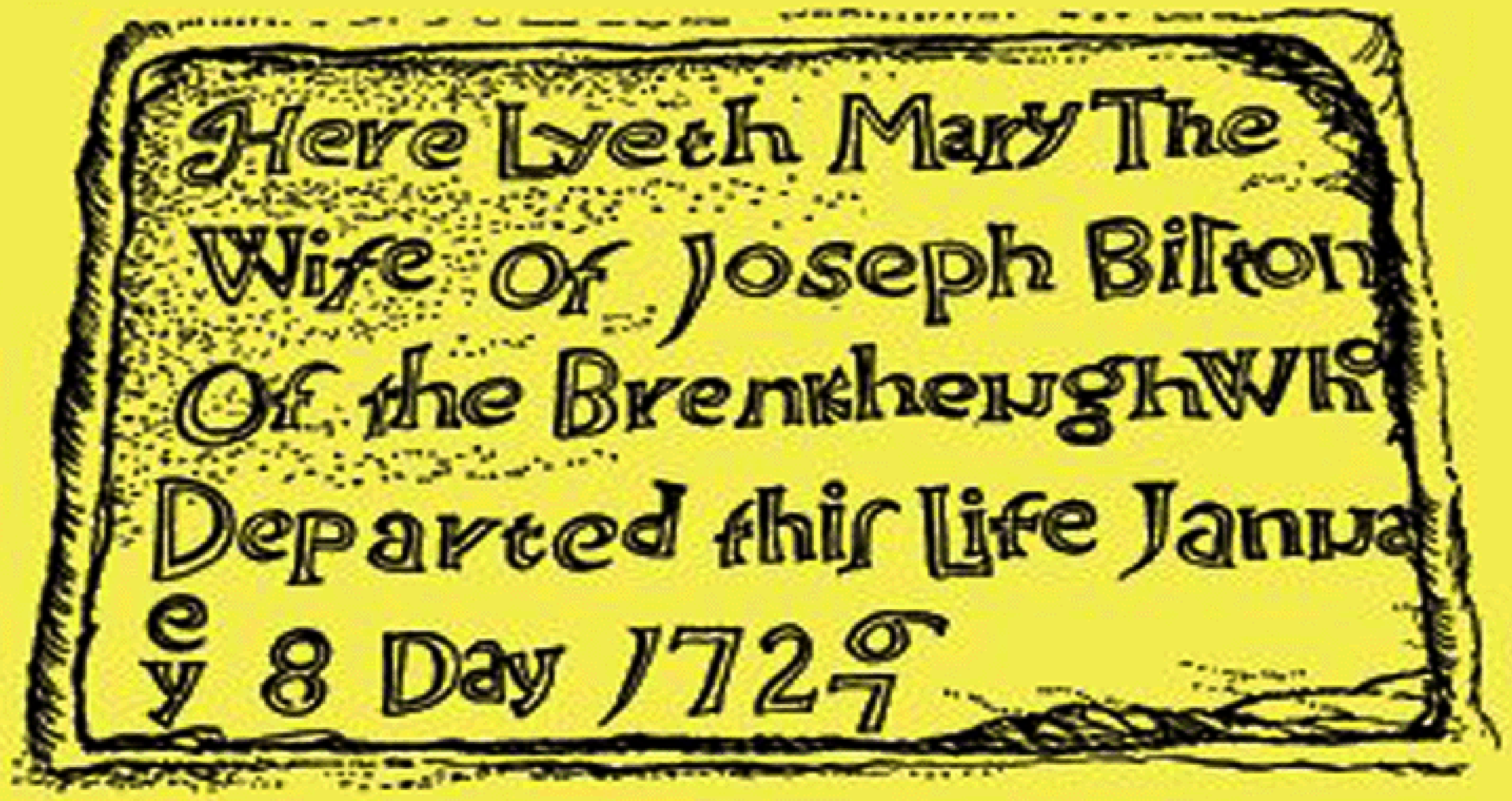
WELCOME TO THE FOLD

A number of examples of Monkey masks have been received and will be published in a later issue

B.A.

continued from previous page

TWO WORDS OF WARNING: (i) Between the 12th century and 2nd September, 1752, the year began not on the 1st January but on Lady Day, 25th March. Charles the First was executed on 30th January, 1649, by our reckoning, but on 30th January, 1648 O.S. (Old Style) as the calendar of the time was called we often write this as 30th Jan., 164^{8}_{9}. (See the illustration of the Northumberland grave stone.) Convert your dates to New Style before applying our rules.



(ii) Don't try to go too far back—our present way of dating as so many years A.D. was not set up until the 4th century and dates prior to that are very suspect.

Good date hunting.

R.M.S.

LETTER TO THE EDITOR

We seem to be in trouble with campanologists everywhere over the article Plain Enough in Issue No. 75 in the Summer 1975. From John Ashmore Dodd, Vice-Captain of Winchester Cathedral we received the following letter.

Dear Sir,

Re letter from Miss C. Barnes of Arborfield, Reading—(Bell-ringing).

The information stated in Mathematical Pie, Summer 76, No. 78 is incorrect in part.

A peal on 4, 5, 6 or 7 bells must contain 5,040 or more changes. The maximum number of changes on 4 bells (an extent) is factorial 4 (24 changes) and 210 of these extents are required. For 5 bells, an extent is 120 changes and 42 of these are required. On 6 bells, an extent is 720 changes and 7 extents are required. On 7 bells, an extent is 5,040 and only one of these is required.

On 8 or more bells the number of changes to complete an extent greatly increases; on 12 being 479,001,600 changes, but on these number of bells, only 5,000 or more unique changes are required to ring a peal.

We are grateful to all who have written in on this item and hope that the above letter will clear up all the problems.

Ed.

TAXI

A friend of yours has hired a taxi to take him to the station and back for £3 for the return journey. You live exactly halfway between his house and the station, and he has agreed to let you share the cab on the way in and out. Quickly now—what ought you to contribute to the cost?

R.M.S.

NUMBER MAGIC

Take the number 12345679. Multiply it by any single digit number. Multiply the answer by 9. What do you notice?

Why do you get this surprising result?

R.H.C.

A DRIVING TEST

If you had to construct motorways to join four towns situated at the four corners of a square, what routes should they be to ensure that the length of roadway is a minimum?

R.H.C.

ONLY IN 632879?

RAIN+
SNOW
SLEET

Replace each letter by a figure and the sum is correct. There are at least two solutions but the title selects the one we require.

D.I.B.

NUMBER PATTERNS

a	3	10	17	19
b	4	10	20	29
c	9	22	39	50

Table 1

a	4	9	49	1
b	8	30	28	22
c	4	25	4	121

Table 2

In each of the tables there is a simple relation between a, b and c. Can you find them?

Make up other tables of a similar nature.

R.H.C.

CUTIE'S PARTY

Cutie Pie invited ten friends to her party. Each friend brought another friend and each friend brought along one brother or sister. Each brother or sister brought a present for Cutie Pie. How many presents did Cutie Pie receive and how many persons were at the party?

A.M.A.

Monday's Child is fair of face

Tuesday's Child is full of grace

Wednesday's Child is full of woe

Thursday's Child has far to go

Friday's Child is loving and giving

Saturday's Child works hard for a living

The child that is born on the Sabbath Day is bonny and blythe, good and gay

Table I: Day remainder

Su	M	Tu	W	Th	F	Sa
0	1	2	3	4	5	6

Table II: Month remainder

J	F	M	A	M	J	J	A	S	O	N	D
0	3	3	6	1	4	6	2	5	0	3	5

Table IV: Century remainder

1800–1899	2	2300–2399	0
1900–1999	0	*2400–2499	6
*2000–2099	6	2500–2599	4
2100–2199	4	2600–2699	2
2200–2299	2	2700–2799	0 and so on

This time we extend our calculation of the day of the week to include past centuries. But first, we need a little calendar history. In Egyptian times the year was taken to be 360 days with an odd 5 days thrown in when they remembered to do it in order to keep the calendar in step with the seasons. In 46 B.C., Julius Caesar, on the advice of his astronomers, adopted a year of $365\frac{1}{4}$ days. He devised a calendar very like our own in which 3 years of 365 days were followed by a leap year pf 366 days.

This Julian year of 365·25 days was, in fact, slightly too long. The true length of the solar year is 365·2422 days. The difference is 0·0078 of a day or about 11 minutes, which in a thousand years adds up to nearly 8 days! In the 16th century, it was noticed that the Spring Equinox was occurring on the 11th or 12th of March instead of the 21st as it should do. The Pope at that time, Gregory XIII, decreed that in 1582 the 4th October should be followed by the 15th, omitting the intervening 10 days. This put the calendar right *at that time* for the Catholic world. However, this country and many other Protestant ones, would have nothing to do with it, and it was not until 170 years later in Britain, i.e., in 1752, that by an Act of Parliament Wednesday, 2nd September, was followed by Thursday, 14th September. The error at that time had amounted to 11 days. The announcement of the Act was followed by riots and cries of "Give us back our 11 days" by people who thought that they were being done out of 11 days of life!

The Gregorian calendar would be no better than the Julian one unless it gave a better approximation to the solar year. This it does by allowing the century years to be leap years only if it is divisible by 400. Thus 2000 will be a leap year but 2100 will not.

Now to business. What we need is the Century remainder for the past centuries. Working back from the table IV, we see that from the 14th September, 1752, to 31st December, 1799, the century remainder will be 4. Prior to the 2nd of September the Julian Calendar makes things easy for us. All we have to do is to take the first two figures of the year away from 18 (Remember that 1752 is in the 18th century and the Julian calendar included a leap year in every completed century year).

Thus for 2nd September, 1752, we have:—

1.	Day of month	2	(2)
2.	Month remainder (Sept.)	5	(5)
3.	Year of century	52	(3)
4.	Leap Year days	13	(6)
5.	Century remainder	1	(1)
		—	—
	(18–17)	73	3

Casting out the sevens we see that the remainder is 3 and so the 2nd September, 1752, was a WEDNESDAY.

One further example: The battle of Naseby was fought on the 14th June, 1645.

1.	Day of month	14	(0)
2.	Month remainder	4	(4)
3.	Year of century	45	(3)
4.	Leap Year days	11	(4)
5.	Century remainder	2	(2)
		—	—
	(18–16)	76	6

After casting out the sevens, we get a day remainder of 6 so that the battle of Naseby was fought on a SATURDAY.

continued overleaf