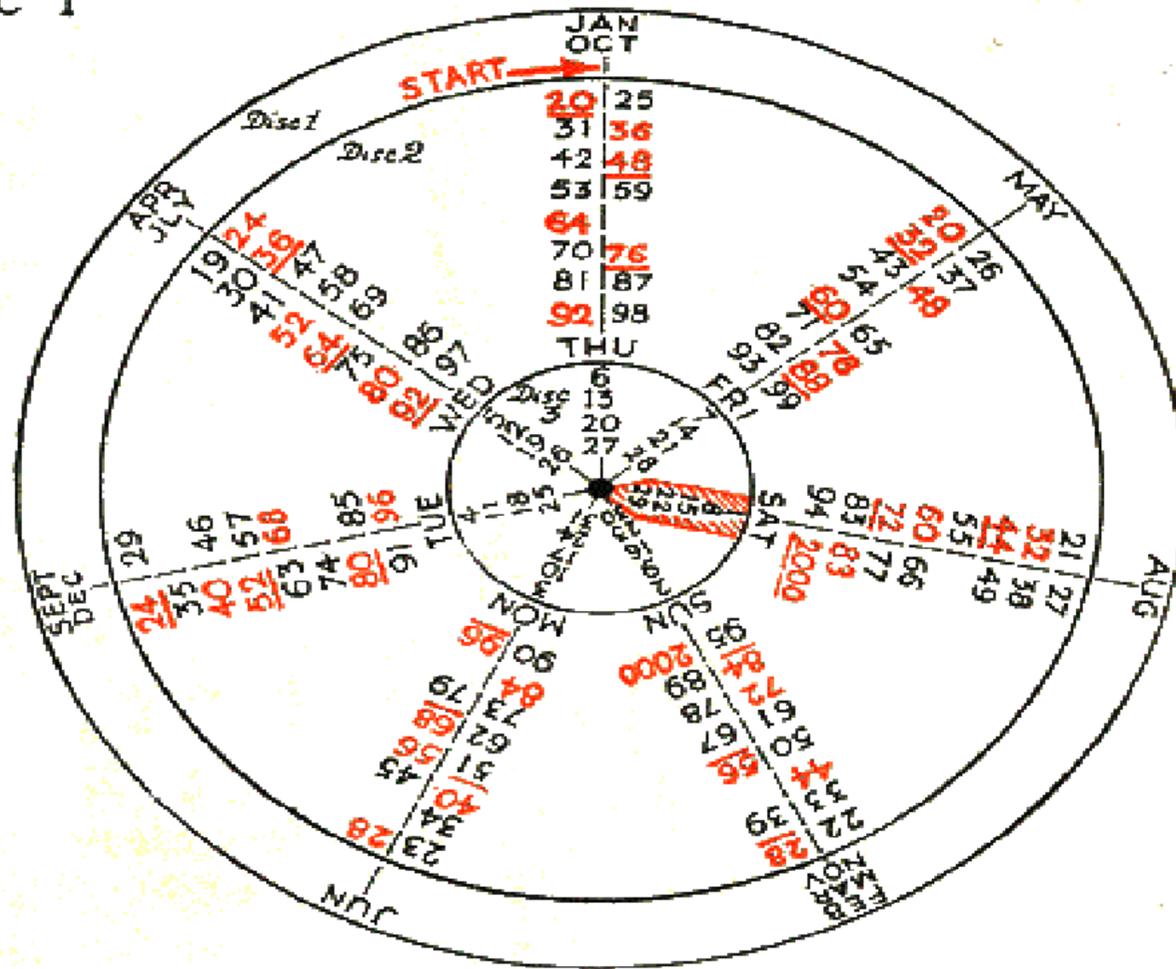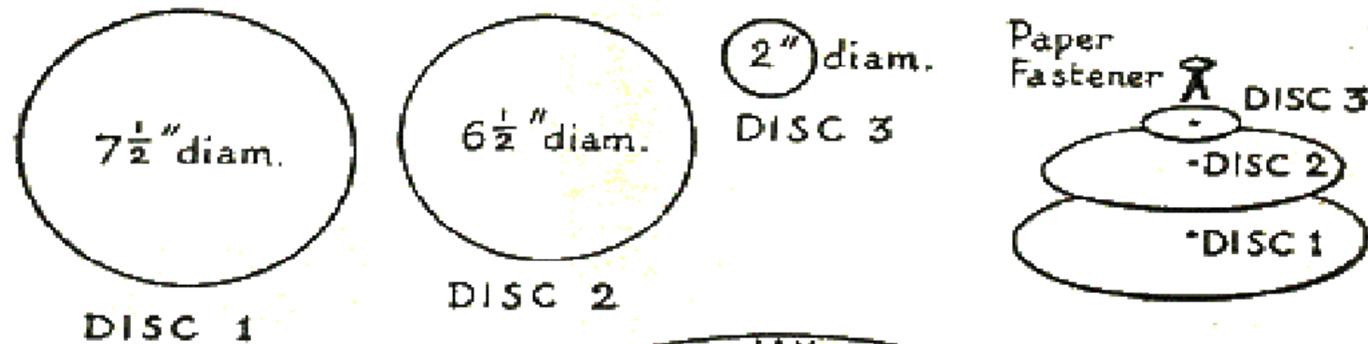## A DATE CALCULATOR

Do you ever search through diaries or, perhaps, make elaborate calculations to find on which day of the week a certain date falls ? This easily constructed model will quickly solve such a problem for any date between 1919 and 2000.

From stiff paper or card, cut three discs with suggested diameters of $7\frac{1}{2}$ inches, $6\frac{1}{2}$ inches and 2 inches respectively. Divide each disc into seven equal sectors ($51\frac{3}{7}$ degrees), lightly drawing the seven radii.

Carefully mark out the discs as shown above. The figures on disc 2 represent the last two digits for each year between 1919 and 1999. Leap years, shown in orange, are entered twice with the first entry under-lined. The day numbers are given on disc 3 with the column 1 to 29 shaded in orange.
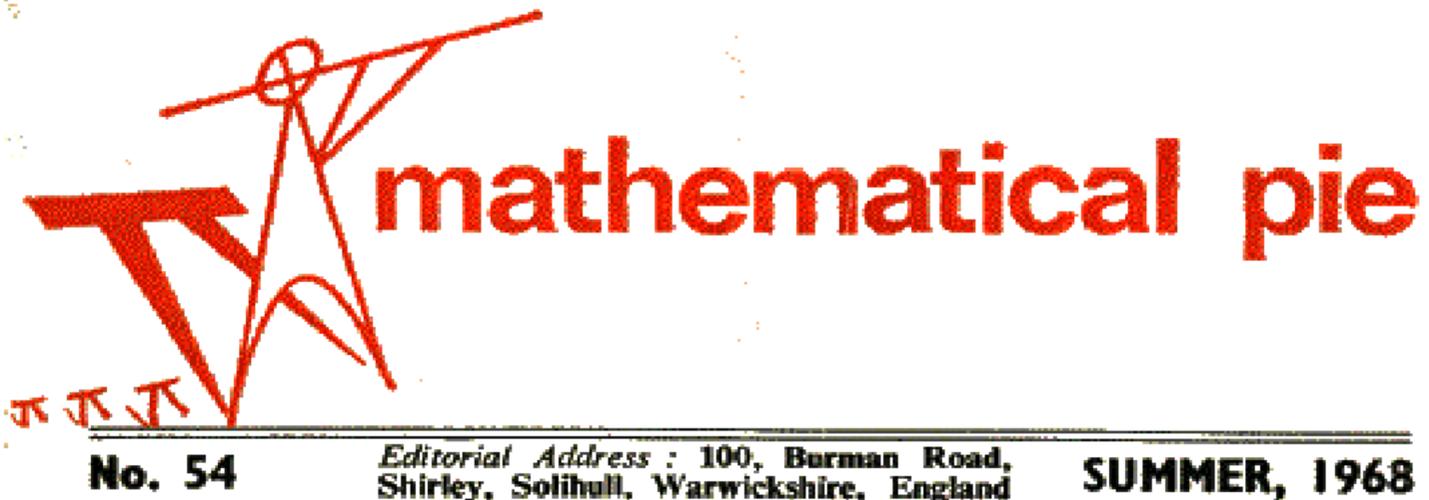
MATHEMATICAL INN SIGNS
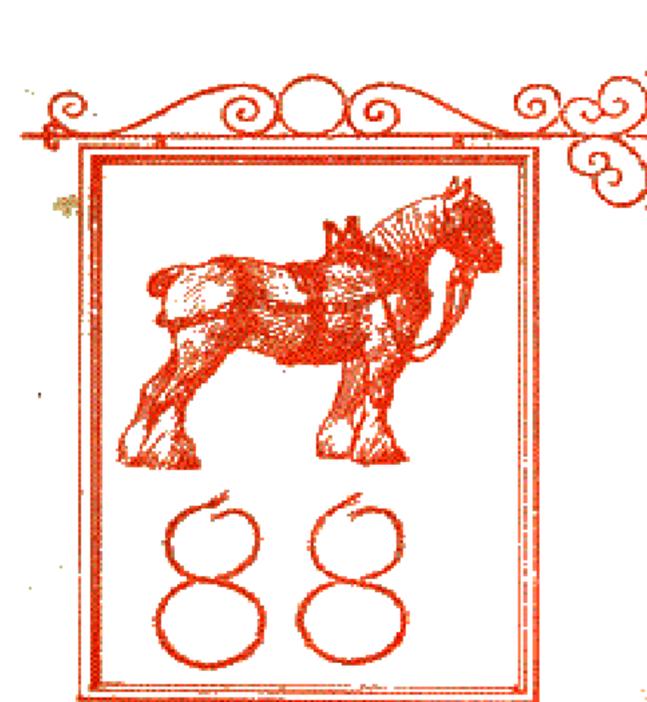
Alan, Eric and myself were passing a country inn with a rather fine sign. We fell to discussing how its name " Goat & Compasses " was a corruption of " God encompasseth us ". This gave us the idea of making up Mathematical Inn signs to while away the journey. Eric stumped the other two of us with the one illustrated. Can you guess what it is *before* you turn to page 427 for the solution.

We thought it might be a good idea for a competition for *Mathematical Pie*. Send in your ideas to the editor, it does not matter if you cannot draw, SHUTL. will do it for you. Book tokens will be awarded for the best " Inn Signs."

R.M.S.

FIND THE NUMBER

Here is a game to impress your friends. Make six cards as shown :—

I					
1	2	5	7	9	11
13	15	17	19	21	23
25	27	29	31	33	35
37	39	41	43	45	47
49	51	53	55	57	59

II					
2	3	6	7	10	11
14	15	18	19	22	23
26	27	30	31	34	35
38	39	42	43	46	47
50	51	54	55	58	59

III					
4	5	6	7	12	13
14	15	20	21	22	23
28	29	30	31	36	37
38	39	44	45	46	47
52	53	54	55	60	61

IV					
8	9	10	11	12	13
14	15	24	25	26	27
28	29	30	31	40	41
42	43	44	45	46	47
56	57	58	59	60	61

V					
16	17	18	19	20	21
22	23	24	25	26	27
28	29	30	31	48	49
50	51	52	53	54	55
56	57	58	59	60	61

VI					
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

Now ask your friend to think of any number from 1 to 60, and to give you all the cards which contain this number. After a glance at the cards you can tell him his number. Can you see how to find the number quickly ?

HOW MUCH CREOSOTE

Recently I wanted to soak some fencing posts in creosote. I decided that the most efficient way was to sink a drainpipe into the ground, fill it with creosote, and dip each end in turn. The posts, made from 4″ by 3″ timber, were 7′ long, and the drainpipe, which was 4′ long had an internal diameter of 6″. A well known theorem told me that the posts would enter the pipe with about $\frac{1}{2}$″ to spare at each corner. Can you spot it?

The problem then was to know how much creosote to buy. What, in fact, was the least number of gallons which would allow me to creosote each post in this way, and what was the largest amount I could put in the pipe to ensure that it did not overflow when the post touched the bottom? S.T.P.

DRAUGHTS

Place a marker at the bottom left hand corner of a chessboard; toss a coin; if it shows heads move one place up the board, if it shows tails move one place to the right. Carry on in this way until you move off the board. What is the probability that you will reach the top right hand corner? A.W.B.

WITHOUT COMMENT

Master introducing Mechanics to a Class : Resolve in two perpendicular directions and take moments.
Pupil : Resolve in two perpendicular directions and take hours.
Submitted by Mr. T. M. Foster, King Edward VII Grammar School, Coalville.

THREE OF A KIND?

(i) If 1 lb. of potatoes costs 4d., how much would 5 lb. cost?
(ii) If a man can see 10 miles from the top of a tower, how far could 5 men see?
(iii) If a 40-piece orchestra can play a Beethoven symphony in 30 minutes, how long would a 60-piece orchestra take? S.T.P.

DISSECTION OF A RECTANGLE

Can you cut a rectangle 3·3 inches by 3·2 inches into 9 squares all of different sides? R.M.S.

Continued from page 428

To find 19th August, 1925 :—

1. Rotate disc 2 until " 25 " is at the Start position on disc 1.
2. Rotate disc 3 until the orange-shaded column is in line with AUG. on disc 1.
3. " 19 " on disc 3 gives " WED." on disc 2. Hence 19th August, 1925, fell on a Wednesday.
4. For leap-years, use the under-lined year numbers for January and February and those not under-lined for the other months.

The calculator can be extended in either direction by following the series given on disc 2. Remember that " century " years are leap-years only if they are multiples of 400. Thus, 1900 was not a leap year.

D.I.B.

JUNIOR CROSS FIGURE NO. 47

CLUES DOWN:

1. A perfect square.
2. 238×12 (base twelve).
3. 5 (base ten) in binary.
4. Area of a circle of diameter 20 inches.
7. Two primes (smaller first) whose sum is 100.
8. The perimeter of a semicircle of radius $24\frac{1}{2}$ inches.
9. The original value of a car which sells for £609 after depreciating by 25%.
11. Acute angle between hands of a clock at 3.20.

CLUES ACROSS:

1. The sum of the faces, vertices, and edges of a dodecahedron.
3. $311 - 122$ (base four).
5. Square yards in an acre.
6. Simple interest (in shillings) on £12 at a rate of 12% per year for 5 years.
8. Area of the triangle in square units of which the vertices are (0, 0); (10, 18); and (22, 10).
10. $2^{10} + 3^3 + 4^0$.
12. Total number of possibilities when 3 dice are thrown together. (Write the digits in the reverse order.)
13. Binary 11110 in base ten.

D.I.B.

SOLUTIONS TO PROBLEMS IN ISSUE No. 53

SOLUTIONS TO PROBLEMS IN ISSUE No. 54

MATHEMATICAL INN SIGNS—Carthorse on cord in eights. (Cartesian coordinates).

HOW MUCH CREOSOTE—The least amount of creosote is 2.5 gallons and the maximum amount is 2.8 gallons.

DRAUGHTS—Roughly 1:5 is the probability of the marker reaching the top corner; 858:4097.

THREE OF A KIND?—(i) 1s. 8d. (ii) and (iii) do not lend themselves to mathematical treatment.

OPERATIONS—$x = 23$ and $y = 10$. $\frac{2}{3} \times \frac{2}{1} = \frac{4}{3}, \frac{3}{2} \times \frac{4}{5} = \frac{12}{10} = \frac{6}{5}, \frac{3}{2} + \frac{4}{5} = \frac{23}{10}.$

SERIES— (i) 552, to each term add the number formed by its first two digits.
(ii) 28, to each term add 3 and reverse the answer.
(iii) 183, to each term add the square of its middle digit.

PINK AND BLUE—4 days. $\frac{15}{16}$ of a can of pink and $1\frac{1}{16}$ cans of blue have been used.

WHAT WILL HE DO?—The boy receives $\frac{4}{7}$ the mother $\frac{2}{7}$ and the girl $\frac{1}{7}$ of the estate. It was intended that a boy would receive twice as much as his mother and a girl half as much.

B.A.

STAMP CORNER No. 24.

Like most of his contemporaries, Tycho Brahe, 1546–1601, believed in astrology. He also believed that astrology could not be an exact science unless there were accurate tables of the movements of the planets. He built instruments of an accuracy that surpassed any others and devised methods of making multiple readings of all angles in such a way that the effects of instrument errors could be corrected. He refused to formulate any hypothesis about the universe or the motions of the planets saying that theory must wait until more facts had been collected. His work was combined with Kepler's until at last enough facts were found for Newton to formulate the idea of universal gravitation.

C.V.G.

WITH RULER, COMPASSES AND SETSQUARE ONLY

Given two triangles, construct
(a)   a third triangle whose area is the sum of the two areas ;
(b)   a fourth triangle whose area is the difference of the two areas.

J.F.H.

SERIES

What is the next item in each of the following sequences ?
(i)   345, 379, 416, 457, 502, —.
(ii)   13, 61, 46, 94, 79, —.
(iii) 125, 129, 133, 142, 158, —.

S.T.P.

PINK AND BLUE

A man uses paraffin for heating and instals a container for it.   Each day he uses half of the contents and each night replenishes the container after the half has been used.   Initially he fills with pink paraffin, but afterwards always tops up with blue.   In how many days use will he have used more blue than pink ?

J.G.

WHAT WILL HE DO ?

I was talking the other day to a solicitor friend of mine, Mr. Twitchet, of Grabham, Grabham, Postlethwaite and Twitchet, who told me about the will of a client of his.   This client was on the point of death when his wife was about to present him with a child.   He made a will in which the child if a boy was to get 2/3 of the estate and the mother 1/3.   If on the other hand the child were a girl, 2/3 of the estate was to go to the mother and 1/3 to the child.
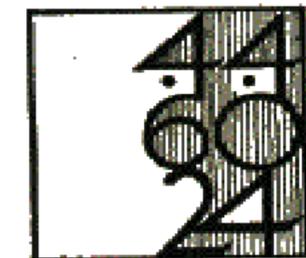
As a matter of fact after his death, twins were born—a boy and a girl. This gave rise to a very nice problem.   How should the estate be divided among the three in the closest possible agreement with the dead man's will ?

R.M.S.

CORN EXCHANGE
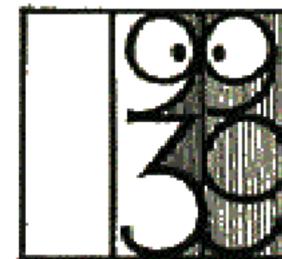
An odd number   An even number

OPERATIONS

$(2,3) \times (2,1) \Rightarrow (4,3)$ and $(3,2) \times (4,5) \Rightarrow (12,10) \Rightarrow (6,5)$

use the same ordered pair notation to find x,y

$(3,2) + (4,5) \Rightarrow (x,y)$.

Illustrate these calculations by writing them out in a different fashion.

R.H.C.

SENIOR CROSS FIGURE No. 50

Ignore decimal points and work to appropriate number of figures. Take π to be 3.142.

CLUES ACROSS :

1.   The length of a rectangle in which the angle between a diagonal and a width is given by $\cos\theta = \frac{1}{2}$.
3.   The original value of a house which sells for £6,905 after an increase of 66⅔%.
7.   Maximum velocity when $v = 208t - 16t^2$.
9.   Area, in square inches, of a scale model which has a length of 1ft. 5in., if the full-scale length and area are 34yd. and 1,480 sq. yd., respectively.
10. $\sqrt{(.1987)}$.
13. Area (reversed) contained between the x–axis, y–axis and the graph $y = 11 - 2x$.
16. 2⅝ in base three.
17. Surface area of a hemisphere of radius 6.93 units.

CLUES DOWN :

1.   Probability of scoring a total of 7 with two dice.
2. $1/(81)^{-\frac{3}{4}}$.
4.   An interior angle of a regular octagon.
5.   Area of a regular octagon described inside a circle of radius 13 units.
6.   Average speed for a journey of 50 miles at 60 m.p.h., followed by 50 miles at 20 m.p.h.
8.   Point of intersection, as an ordered pair, of $y = 2x - 8$ and $y = 3x - 14$.
11. Shortest closed boundary in a plane which will contain an area of 15,400 sq. units.
12. £8.1.3d. in dollars if the rate of exchange is $12 = £5.
13. Volume generated by rotating $x^2 + y^2 = 25$ about the x-axis.
14. Eleventh term in the series 2304, 1152, 576, 288, –, –.
15. Roots (smaller first) of $x^2 - 7x + 12 = 0$.
16. Area of a rhombus of side $2\sqrt{(14)}$ units, with an obtuse angle of 150°.
18. Latitude of a point at sea level on the earth's surface which has a rotational speed of 640 m.p.h. (Radius of the earth = 3960 miles).

19. Next two terms (larger first) in the series : 0, 3, 8, 16, 29, –, –.
20. $10^{1 \cdot 3979}$.

D.I.B.

The driver of a car need not know how to refine petrol nor how to make tyres nor anything at all about the works. He does need to know what the pedals and steering wheel are for. If one imagined that the car had a brain, one might suppose that the driver used the pedals and steering wheel to give the car its orders in the same way as a rider uses reins and spurs to give orders to a horse.

A man who writes a program for a computer has no need to know how the computer works ; he quite likely never sees it. He writes out a list of instructions and a punch operator types these out on a teleprinter which produces a length of perforated paper tape. The computer " reads " this tape and then prints out the answers.

The programmer needs to know what the computer can do and how to write out the necessary orders. Most British and European computers will accept orders in a language called ALGOL.

A computer cannot do algebra like " *simplify* $3a+2b\div4a$ " or " *factorise* $a^2 - 4b^2$," but it can substitute numbers into complicated formulae and evaluate the results in a fraction of a second.

The problem " *If* $V=\frac{1}{3}\pi h\ (r^2{}_1+r_1r_2+r^2{}_2)$, *calculate V when* $h=3.84$, $r_1=2.96$, *and* $r_2=5.48$," might be written for a computer as :—

```
"PIE 100" ;
"BEGIN" "PRINT"(3.141592*3.84*(2.96*2.96+2.96*5.48+5.48*
    5.48)/3) ;
"END" ;
```

PIE 100 is a " title." Every computing centre has its own rules for titles to ensure that the results reach the right person. In the formula all the letters and numbers must be in line so " $\frac{1}{3}$ " is changed to " *divide by 3*," * is used for *multiply by* and / for *divide by*. " PRINT " means *print the value of*.

A program to be used to evaluate this formula with different sets of values for h,r_1 and r_2 might be written as :—

```
"PIE  101" ;
"BEGIN" "REAL"V,H,R1,R2 ;
    "READ"H,R1,R2 ;
    V:=3.141592*H*(R1*R1+R1*R2+R2*R2)/3 ;
    "PRINT"V ;
"END" ;
```

The first line lists all the symbols used in the program to represent numbers. These symbols or indentifiers need not be single letters, words such as *VOLUME* or *AREA* are quite acceptable. The next line instructs the computer to read the values from a list of numbers punched on a data tape. In the third line the symbol := is read as *becomes*. All multiplication signs must be written.

The words of command have to be distinguished from words used as identifiers. In a program written for an Elliott computer, this is done by putting command words in inverted commas ; for an English Electric machine the command words are underlined.

If you wish to try writing formulae evaluation programs, you need also to know that x^3 can be written as either $X*X*X$ or $X\uparrow3$ and $\sqrt{x}$ as $SQRT(X)$ or as $X\uparrow(1/2)$. The symbol $\uparrow$ means *to the power of*. For trigonometrical functions, the angles must be in brackets, e.g. $COS(X)$.

C.V.G.