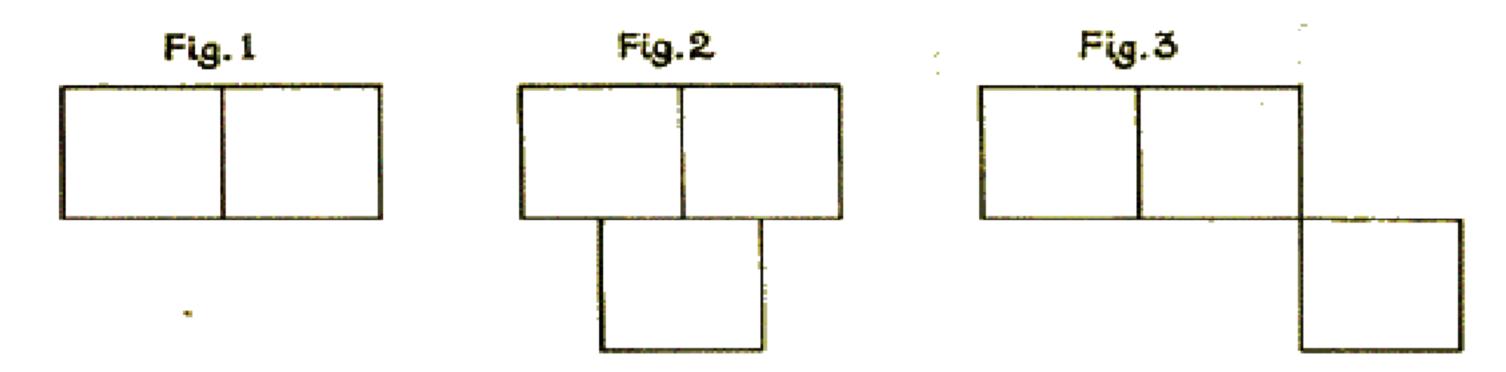
POLYWHATSITS

Have you ever investigated the shapes called POLYOMINOES? If so, then don't skip this article altogether; jump to the part below the figures. If not, here is a brief description.

Everyone knows the shape of a domino—it is made in the shape of two squares placed edge to edge (Fig. 1). Suppose we extend this idea to three squares, and call this shape a *triomino*. We keep the edge to edge rule, so that shapes like Fig. 2 and Fig. 3 are NOT allowed. There are two possible shapes for such a triomino; a rectangle and an L shape.

It is an interesting, and quite challenging, exercise to try to find all the possible *tetrominoes* and *pentominoes*, or even all the *hexominoes*. Many people find that they mistakenly include duplicates (for we do not count two *polyominoes* as different if one can be turned round or turned over to fit on to the other).

Although there is general agreement as to the number of each type of polyomino for those made up of a small number of squares, you will realise that the problem becomes complicated and tiresome for larger polyominoes. So far, no one has been able to find a formula connecting the number of distinct "n"-ominoes with the number n of squares used to make each one.



Now that we all know what a polyomino is, here is a slightly different idea. Suppose that the shapes are made from equilateral triangles instead of squares. How many different shapes can be made with 2, 3, 4 or 5 triangles? Perhaps we should not call these polyominoes. Do readers have any suggestions for a name? Remember that the ending you choose must fit well after poly-, do- (or duo-, or bi-, or di-), tri-, tetra- (or quad-), etc. If this investigation has caught your interest, you might like to try a similar one based on a "unit" of a rhombus with its angles 60° and 120°.

E.G.

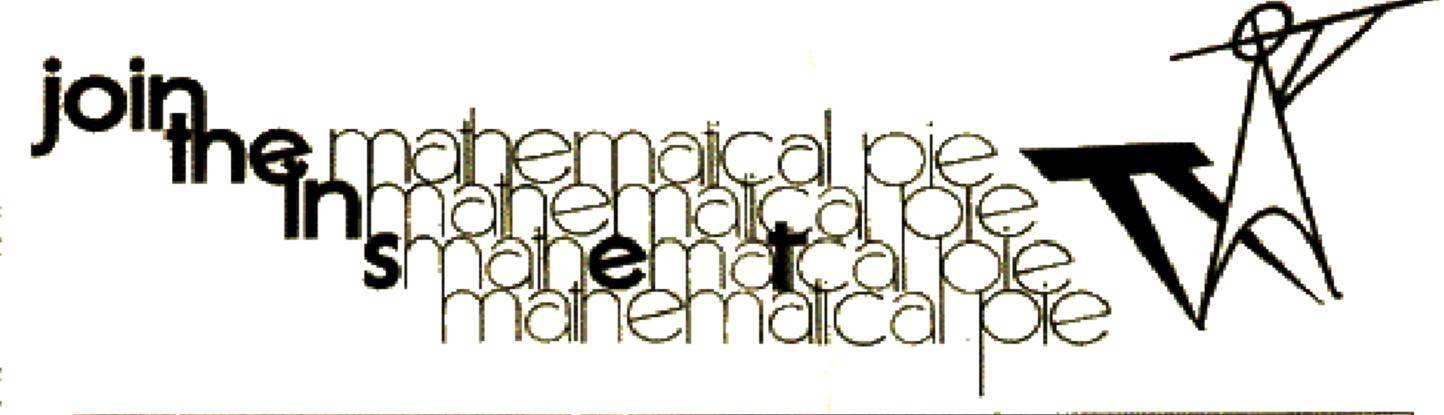
THE CLOSED SEASON

Charleot Manor is closed from the last day of October until the first possible day that it can open in April subject to the conditions that it is closed on Mondays and Good Friday but open on other Bank Holidays.

A man arrives on 2nd November, 1971, to find the Manor closed. How many days will pass before he can visit the Manor house?

What complications could arise in other years?

R.H.C.



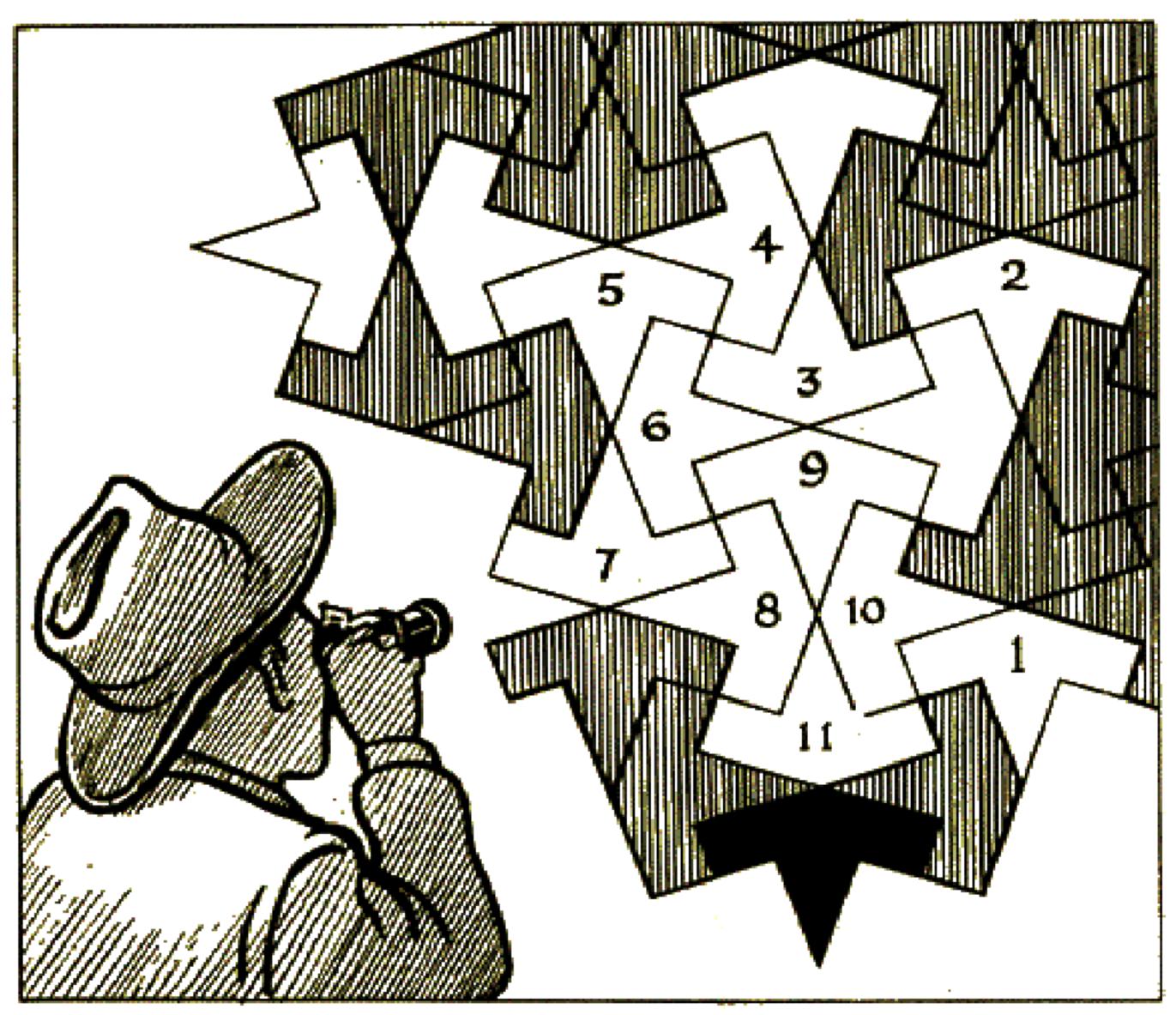
No. 62

Editorial Address: 100, Burman Road, Shirley, Solihuli, Warwickshire, England

SPRING, 1971

A NIGHT ON THE TILES

Imagine my surprise, on holiday in Spain, when I bumped into my old American pal, Al Gebra! I was wandering through the Alhambra in Granada when I saw him studying a tiled wall like the diagram below.



"Hi, man!" he cried, "don't need no interpreter to translate this!" for he had noticed the repetitions such as 1 to 2 which when regarded as movements would be called translations. (Al is very keen on the latest wordplays; he calls them "current puns".)

I was determined not to be outdone, "Are you sure you have the right angle on it?" I asked, pointing out the movements 3,4,5,6 and 6,7,8,9.

"O.K. You have had a turn, now here's mine" he replied, showing me the rotations 8 to 10 and 9 to 11. (We couldn't think of these as "reflections" because only one side of a tile can be used—the other side of a tile is rough for fixing to the wall.)

I was reminded of Alice's teacake (issue No. 58), so we decided to call the movements after the letters in the name of my hero ASTLE.

A means translate nosewards, e.g., 1 to 2.

S means rotate 90° anti-clockwise around the right wing, e.g., 3 to 4.

T means rotate 90° anti-clockwise around the left wing, e.g., 7 to 8.

L means rotate 180° around the nose, e.g., 8 to 10. E means rotate 180° around the tail, e.g., 9 to 11.

"Let's tesselate, Al", I said, and using the movements we tried to find what my sentence would do to a tile, by doing L, then E, then T, and so on. Can you help us? Start on the black tile.

Many of you did very well with the "teacake": can you find rules for this game? For instance, what are the results of the following (i) LL, (ii) SSSS, (iii) TS, (iv) ST, (v) TSST?

Are the results always the same, no matter where you start? How can you tell that I am a better mathematician than Al? Can you find any other interesting sentences?

Note.—" tessellate" has been deliberately spelled incorrectly. Why do you think this was necessary;?

E.G.

A GALAXY OF TALENT

submitted by J. Cameron, Esq., Hastings

The Anglo-Saxon race, in its colonisation of the Galaxy, has carried the pleasures of civilisation to the furthest star: cricket is played throughout the Milky Way.

I was a little late arriving for the match between the Algoliwogs and the Bellatrixters, two leading teams whose performances compare well with English county standards; and as I took my seat the Algoliwog spectators rustled their tentacles in appreciation. "That puts the 200 up" one of them said; but alas, only one run more was scored before the wicket fell.

"All out for 100", said a Bellaxtrixter, applauding by twinkling the band of eyes which encircled his head.

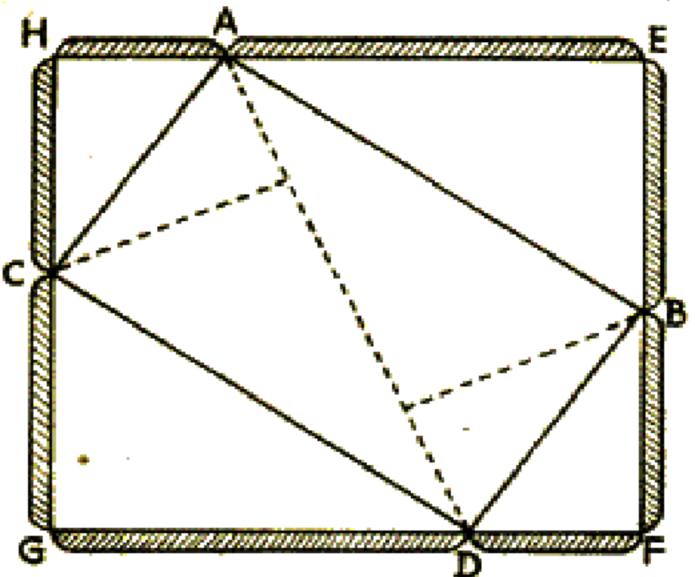
I know that, just as I base my reckoning on my ten fingers, the Algoliwogs base theirs upon the number of their tentacles; and the Bellatrixters upon the number of their eyes: so if both my informants were correct in their own reckonings, what was the score for the winnings in mine?

ADDITIVE POWER

Which positive whole number is actually more when increased by 1,000 than when it is multiplied by 1,000?

R.H.C.

HOW TO MAKE AN ENVELOPE

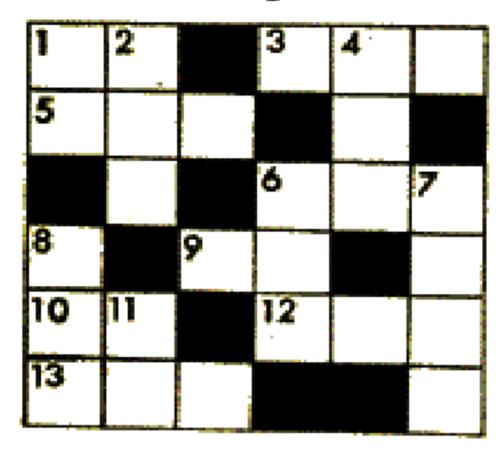


A point A is fixed on the side EH of a square EFGH. Explain how to complete the figure.

When the figure is complete, the corners of the square EFGH are folded over as shown by the dotted lines. How many cyclic quadrilaterals appear in the figure?

R.H.C.

JUNIOR CROSS FIGURE No. 54



Ignore decimal points.

CLUES ACROSS

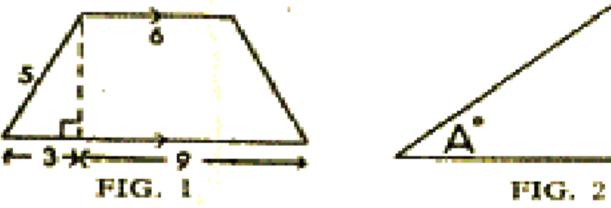
- One new penny in old pence.
- (Digit sum of 5 across) × (Digit sum of 13 across).

- 5. $(2a+b-c)^2$ when a=10, b=7,
- Interior angle of regular polygon with 20 sides.
- Area of trapezium in Fig. 1.
- 10. Last number with two digits.
- Consecutive integers.
- 13. $2x^2-2$ when x=20.

CLUES DOWN

- 1. Square number plus 1.
- Product of two consecutive integers.
- 4. 48% of £3.25 in new pence.
- Sum of the remaining angles in the triangle in Fig. 2 when A is 19.
- 7. Next two terms in the sequence 2,5,10, 17,
- Total surface area of cylinder diameter 7 cm. height 10 cm.
- 11. 11/10 of 1 right angle in degrees.





SOLUTIONS TO PROBLEMS IN ISSUE No. 61

CHARLIE COOK AGAIN—He had 3 questions correct out of 7 in part 1 and 4 correct out of 5 in part 2 making 7 correct out of 12 on the whole paper.

A BASE QUESTION No. 2—The relation can be extended to the case when a = 8 and c = 9. The bases will be 18 and 17. HIGH FINANCE—The smallest sum of money is £345,678 12s. 9d.

SENIOR CROSS FIGURE No. 57
Clues Across: 2, 768; 5, 4576; 7, 62; 8, 766; 10, 667; 12, 981; 13, 452; 15, 48; 16, 3646; 19, 132.
Clues Down: 1, 24; 2, 77; 3, 667; 4, 32; 6, 55648; 7, 66834; 9, 69; 11, 75; 14, 233; 15, 48; 17, 62; 18, 60.

WRAP UP—The first parcel is a 1) ft. cube. The second parcel with a square section is 0.6 ft. square by 3 ft. The volume is 27/25 cubic feet.

JUNIOR CROSS FIGURE No. 53

Clues Across: 1. 24; 3, 100; 5, 5279; 6, 827; 8, 144; 10, 7387; 12, 525; 13, 15. Clues Down: 1, 25; 2, 4224; 3, 198; 4, 007; 7, 2381; 8, 125; 9, 475; 11, 75.

SHORT PUZZLES—(i) 99 1 5 (ii) 4.

B,A.

P.J.G

Without adhering strictly to the conditions of the Official Index, some readers may wish to observe changes in the cost of living by working out their own monthly or termly indices. By carefully comparing the relative importance of various items and considering the group weightings given in this article, section weightings could be produced. The same goods and quantities must be included on each occasion and the same weekday selected for the research.

Those who wish to pursue this subject in depth should read "Studies in Official Statistics No. 6" (H.M.S.O.), price 20p, and "Department of Productivity Gazette for March, 1970" (probably obtainable at the local library), the latter giving the section weightings for 1970.

LOOK BEHIND THE MIRROR No. 3

As a result of the articles Look Behind the Mirror in issues No. 57 and 59, R. L. Worrall of Sevenoaks wrote that he was "a bit uncertain about the reasoning". We had suggested that 247 behind the mirror was 367 in normal counting. Our argument had been that in writing our numbers as you normally do, 367 means $3(10)^2+6(10)+7(10)^\circ$. If behind the looking glass the number base is -10 and not 10 then 367 would mean $3(-10)^2+6(-10)+7(-10)^\circ$. As $(-10)^2$ equals $(-10)\times(-10)$ or +100, etc., the above number is really equivalent to, in normal language, 300-60+7, i.e., 247. Similarly the number 247 behind the looking glass would be equivalent to $2(-10)^2+4(-10)+7(-10)^\circ$ or 200-40+7, i.e., 167.

Mr. Worrall felt we had not gone far enough and that each of the digits should also be treated as having a negative value. This means that if I were really behind the looking glass, when I wrote 2, it really meant -2, so we must start our reasoning again. 367 would then translate into $-3(-10)^2+(-6)(-10)+(-7)(-10)^\circ$. This would work out to be -300+60-7 or -247. Similarly the number 247 would translate to $-2(-10)^2+(-4)(-10)+(-7)(-10)^\circ$ or -200+40-7, i.e., -167.

Enough has now been said to introduce Mr. Worrall's idea, can you give his version for the numbers usually written 1,2, . . . , 11,12, . . .

For Fourth Formers and older Readers

Mr. Worrall gave 367 as $-3(-10)^2 + \{-6(-10)^1\} + \{-7(-10)^9\}$ or $(-3 \times 100) + (-6 \times -10) + (-7 \times -1) = -233$. Can you find the mistake that he made?

We also thought that even he did not go far enough with the idea for the indices ought to be negative so that 367 really means $?3(-10)^{-2}+(-6)(-10)^{-1}+(-7)(-10)^{\circ}$. Can you find the number that this works out to be. Some of you might find this last translation a fruitful field for investigation.

R.H.C.

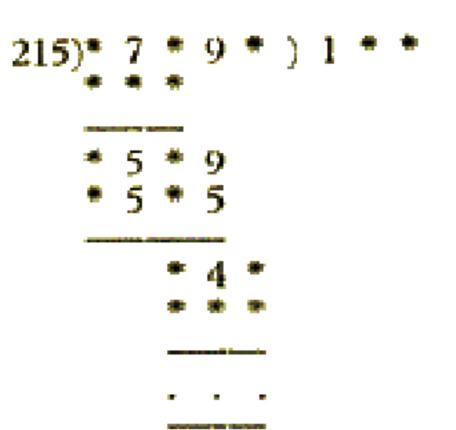
AN ACADEMIC DILEMMA

Charlie Cook was born on 8th September, 1741. He usually grumbled that he had to return to school on his birthday. When he was 11 years old, he didn't know whether to be glad or sorry.

Why ought he to be more upset than usual?

R.M.S.

MISSING FIGURES



Replace the * by digits so that the division is correct.

R.H.C.

INCOMPLETE CHANGE

What is the largest sum in silver that I can have in my pocket without being able to give change for a fifty pence piece? Was the answer the same before the change to decimal currency?

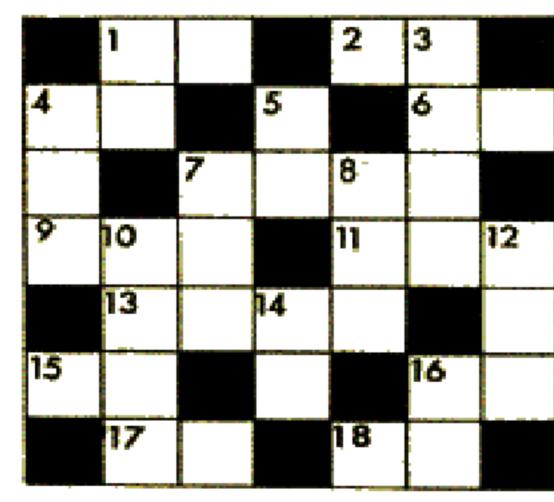
R.H.C.

THE POWER GAME

Divide the twelfth power of 4 by the eleventh power of 4 and multiply the answer by the number whose square root is equal to its cube root.

R.H.C.

SENIOR CROSS FIGURE No. 58



Ignore decimal points. Take # to be 3.142.

Clues Across

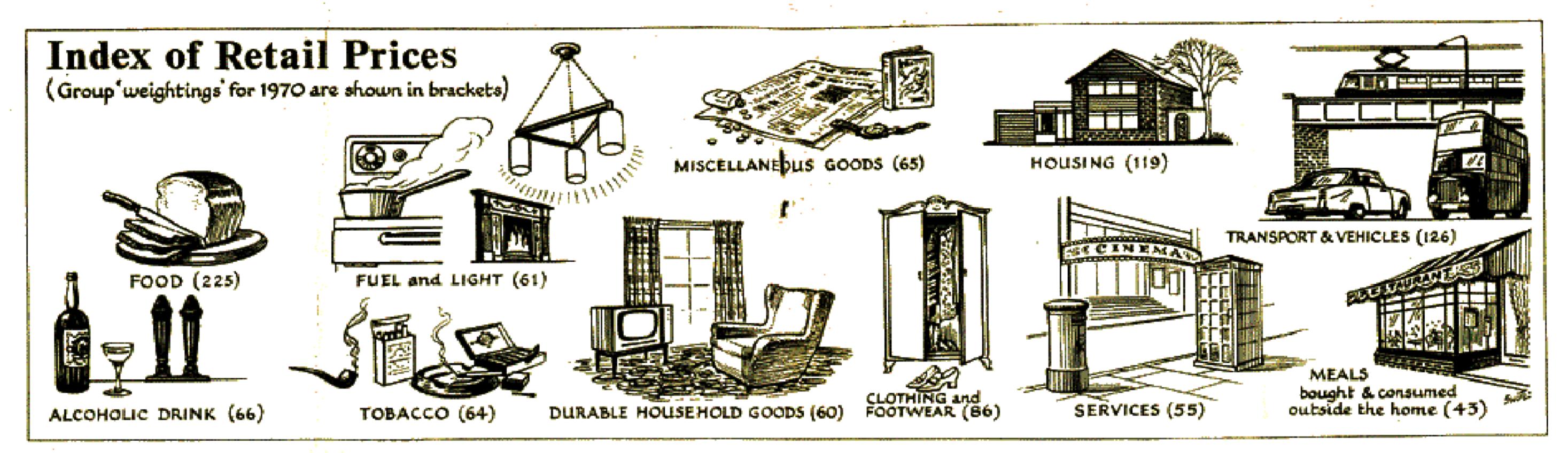
- 1. Gradient of $y = x^3 2x^2 10x + 1$ at x = 6.
- Total number of ways of throwing 2 dice so that the sum is less than or equal to 7.
- Number of vertices of a dodecahedron.
- 6. Area between $y = 3x^2 + 2x + 2$, x = axis, x = 0, and x = 4.
- 7. Positive root of $x^4 7x^2 \cdot 8 = 0$.
- 9. y is proportional to \sqrt{x} ; y=45 when x=81, find y when x=729. =2/3 0.5 1/7
- 11. (0.125) $\times (529)$ $\times (128)$. 13. Distance along line of latitude

- 61°N between 80°W and 86.8 E.
- 15. Pound away at the weighty problem of one quarter minus one.
- Velocity attained in 2 seconds by a body falling from rest. (g = 32 ft. sec = 2).
- True speed of boat moving at right angles to current of 2.5 knots if still water speed is 6 knots.
- Next term in the sequence −2, 1, 6, 13, 22, 33.

Clues Down

- 1. Coefficient of x^4 in the expansion of $(1+x)^2$.
- Slant height of cone of total surface area 238 sq. cm. and base radius 3.4 cm.
- Sum of the first 21 positive integers.
- 5. $Log_264 \times log_327$.
- 7. Radius of sphere when ratio of volume to surface area is 85:1.
- Area of triangle with sides 10" and 12" and included angle 21° 18'.
- Log tan 246°18′.
- 12. Volume of revolution formed when $y = x^2$ is rotated about the y—axis between y = 0 and y = 17.
- Square number whose digit sum equals that of its square root.
- If distance after time t sec. equals 3t+t³, find acceleration when t == 11.

P.J.G.



The Index of Retail Prices (often incorrectly called the Cost of Living Index) covers the eleven groups shown above, which in turn are divided into a total of ninety-three sections. Most sections are further sub-divided into items: e.g., in the Food group, the Bread section comprises white 13 lb. and 14 oz. loaves and the brown 14 oz. loaf. Consideration must be given to the importance of each section. After all, most households would be expected to spend much more on bread than on cooking-fat. To allow for these relative differences, "weightings" are given annually to each section. In the same way, each group has an annual "weighting" (the sum of the weightings for each section in that group) which ensures that the all-items Index finally evaluated is accurate. Although the group weightings for 1970 are shown, space is too limited here to give the weightings for each section.

Table (i)					
Section	Rise in Price %	Section Weighting	Rise in Price % × Section Weighting		
Bread	$\frac{12-10}{10} \times \frac{100}{1} = 20$	16	320		
Cornflakes	$\frac{10-8}{8} \times \frac{100}{1} = 25$	4	100		
		20	420		

Percentage increase $=\frac{420}{20}$ = 21

Therefore, Group Index=100+21=121 (With previous January as 100).

As the index measures only price *changes*, prices of the *same* goods and services must be collected. The percentage increase or decrease is calculated on the base value of 100 representing the index for the previous January. The procedure for calculating the index is probably best explained by simple examples.

Supposing that the Food group consists of only two sections, a white 1\frac{3}{4} lb. loaf and a 12 oz. packet of cornflakes, table (i) shows the calculation if the January prices of bread and cereal rise from 10p to 12p and 8p to 10p, respectively.

Instead of the eleven groups, a further simplification will be made by supposing that there are only two groups, Food (which, covering a large number of important items, actually has a total weighting of 255 and not 20 as indicated) and Durable Household Goods (which has a total weighting of 60).

Table (ii)

Group	Rise in Price %	Group Weighting	Rise in Price % × Group Weighting
Food Durable	21	20	420
Household Goods	5	60	300
		_	
		80	720
		-	

Retail Price Index= $\frac{720}{80}$ + 100 = 109 (With previous January as 100).

The Retail Price Index, issued monthly by the Department of Productivity, is based on an index of 100 in January, 1962.

continued on page 490