# LEISURE LINES

on postcards only (letters are automatically disqualified) to *PCW* Prize Puzzle, April 85 Leisure Lines, 62 Oxford Street, London W1. Entries to arrive not later than 31 May 1985.

## *January Prize Puzzle*

Cries of 'Easy', 'I didn't need a micro for it', and 'When are you going to give us a really difficult problem' greeted the puzzle about the missing pages in my book. Funnily enough, although there was a good response — over 230 entries — about 15 per cent contained incorrect answers.

Anyway, the answer required was 59-92. One other possible answer was the two pages 1283-1284, but we did say that a whole section was missing. Finally, the answer 143-159 is not valid since page 143 could not be missing unless 142 was also; the same with pages 159 and 160. Try it and see. And as for those who said page 2567 on its own — well, really!

The winner drawn from the prize-hungry mob at random was Mr Anthony Hiorns of Aberystwyth. Congratulations Mr Hiorns, your prize is on its way.

Meanwhile, many thanks to those of you who have sent in ideas for puzzles. Two or three came with this month's batch of puzzle entries and we're looking closely at them for future use.

# NUMBERS

*A simple problem on sums of powers from Mike Mudge.*

In 1851 E Poulet noticed that the integers 1,2,3, . . . 27 could be separated into three sets, each having the same sum and sum of squares. Thus (1,6,8,12,14,16,20,22,27); (2,4,9,10,15,17,21,23,25); (3,5,7,11,13,18,19,24,26) where the sum of the numbers in each set is 126 and the sum of their squares is 2310.

In 1911 E N Barisien separated the integers 1,2,3, . . . 32 into four sets having the same properties. Thus (1,8,10,15,20,21,27,30); (4,5,11,14,17,24,26,31); (2,7,9,16,19,22,28,29); (3,6,12,13,18,23,25,32) with sum 132 and sum of squares 2860 in each set.

In 1913 G Terry quoted (1,12,21,43,52,63) and (3,7,28,36,57,61) as having the same sum, sum of squares, of cubes, of fourth powers and of fifth powers.

**Theorem** (G Terry 1912) The first $2^n(2a+1)$ integers can be separated into two sets, each having the same number of elements and the same sum of $t^{th}$ powers for t = 1,2 . . . n. For example: a = 1, n = 3, (1,3,7,8,9,11,14,16,17,18,22,24) and (2,4,5,6,10,12,13,15,19,20,21,23) each have sum of 150 sum of squares equal to 2450 and sum of cubes equal to 45000.

**Problem** Write a computer program to input n and a, and to output the two sets together with their sums of $t^{th}$ powers for t = 1 . . . n . . . then investigate the possible generalisation of each of the following:

(1,5,10,16,27,28,38,39) $\underline{6}$ (2,3,13,14,25, 31,36,40)

(1,5,10,24,28,42,47,51) $\underline{7}$ (2,3,12,21,31, 40,49,50)

where $\underline{n}$ denotes that the sets have equal sums of the $k^{th}$ powers for k = 1,2, . . . n.

Readers are invited to submit their program listings, output and hardware details to Mike Mudge, 'Square Acre', Stourbridge Road, Penn, Nr Wolvehampton, Staffordshire WV4 5NF. Tel: (0902) 892141.

A suitable prize will be awarded to the best entry received by 1 July 1985.

*Please note that submissions can only be returned if a suitable stamped addressed envelope is provided. Expanded reviews of previous Numbers problems together with, subject to the approval of the contributor, copies of detailed programs from prize winning entries may also be requested.*

## *Binomial Coefficients, October 1984*

This problem attracted a small response, due probably to the amount of algebra in its formalism. However, these notes and results may encourage readers to return to it.

(i) k = 7 has associated n values 21, 30 and 54; no others are known.

(ii) For a full discussion of this problem see P Erdös and G Szekeres, *Some Number Theoretic Problems on Binomial Coefficients,* Australian Mathematical Society Gazette Vol 5 (1978) pp97-99.

(iii) There was a misprint: $\binom{14}{9}$ should read $\binom{14}{4}$.

(iv) The sequence of n values is 1,10,756,757,3160,3186,3187,3250, 7560,7561,7651,20007,59548377 and 59548401; other much larger values are known. For further discussion see P Erdös *et al* on the prime factors of $\binom{2n}{n}$, *Mathematics of Computation* Vol 29 (1975) pp83-92.

This month's prize winner is AS Tickner of Pinner, Middlesex, using Basic on a ZX81 extending (i) to include k = 13, n = 33,36,56; k = 17, n = 36. In (ii) the primes were studied up to 599. Further studies by Mr Tickner used an HP 85 together with some algebraic insight into binomial coefficients.

If k is greater than or equal to 9, is it true that three is a factor of

$$\binom{2^k+1}{2^k}$$

Albebra can be intimidating, but a little research and commitment works wonders!

# MICROCHESS

*Kevin O'Connell looks at Elite X's winning moves at the Fourth World Microcomputer Chess Championship*

**White: Elite X. Black: Psion. Sicilian Defence. Notes by Kevin O'Connell.**

It's no good having a won game unless your technique is good enough to convert that position into the full point, as testified by the following game from the Fourth World Microcomputer Chess Championship played in Glasgow last September.

| | | |
|---|---|---|
| 1 | e2–e4 | c7–c5 |
| 2 | Ngl–f3 | Nb8–c6 |
| 3 | Bfl–b5 | e7–e6 |
| 4 | 0–0 | Ng8–e7 |
| 5 | c2–c3 | a7–a6 |
| 6 | Bb5×c6 | Ne7×c6 |
| 7 | d2–d4 | c5×d4 |
| 8 | c3×d4 | d7–d5 |
| 9 | e4–e5 | |

(This assures White of a lot of extra space; it also fixes the backward pawn on d4 as a permanent weakness and long-term target for Black.)

| | | |
|---|---|---|
| 9 | . . . | Bf8–e7 |
| 10 | Nb1–c3 | 0–0 |
| 11 | Bc1–f4 | Bc8–d7 |
| 12 | Qd1–d2 | Qd8-b6 |
| 13 | Rf1–c1 | Rf8–c8 |