DIARY DATA

A look ahead at computer shows to May 1988. Readers are advised to check details before setting out on their journey.

OFFICE UPDATE NEC, Birmingham — Andrew Centre (01) 891 5051 Ext 285	**19-22 January 1988**
WHICH COMPUTER? SHOW NEC, Birmingham — Cahners, Belinda Caver (01) 891 5051	**19-22 January 1988**
AMSTRAD COMPUTER SHOW Alexandra Palace, London — Database Exhibitions (061) 456 8383	**29-31 January 1988**
COMPUTERS IN RETAIL AND RETAIL TECHNOLOGY NEC, Birmingham — Focus Events (01) 834 1717	**15-17 March 1988**
ELECTRON & BBC MICRO USER SHOW UMIST, Manchester — Database Exhibitions (061) 456 8383	**18-20 March 1988**
ELECTRONIC PRINTING AND PUBLISHING EXHIBITION Olympia, London — BED Exhibitions (01) 647 1001	**22-24 March 1988**
COMPUTERS IN TRANSPORT AND DISTRIBUTION Wembley Conference Centre, London — Computers in Transport and Distribution (0303) 45979	**19-21 April 1988**
ATARI COMPUTER SHOW Alexandra Palace, London — Database Exhibitions (061) 456 8383	**22-24 April 1988**
COMFEST '88 Telford Exhibition Centre, Telford — (0952) 505522	**12-14 May 1988**

NUMBERS COUNT

Mike Mudge moves his 'number theory' into the practical world of chess.

This month it is assumed that readers are familiar with the basic modes of travel of Queens, Knights, Rooks and Bishops during a chess game.

The Challenge

The problems to be considered, while soluble with a set of very small positive integers, require considerable 'logic' for their efficient analysis together with ingenuity to display any solutions obtained and, finally, inspiration to find a general algebraic theory to explain what is happening.

Problem I. How many Queens?

What is the minimum number, f(n), of Queens that can be placed upon an n x n chess board (the standard board being 8 × 8) so that no Queen is guarding (watching) any other Queen, and also so that the entire board is being guarded (watched) by at least one Queen?

Partial solution

n 5 6 7 8 9 10 11 12 13 14 15 16 . . .

f(n) 3 ? ? 5 ? ? 5 ? ? 8 ? ? . . .

Problem II. How many pieces?

What is the minimum number of pieces of the same type that can be placed upon a standard (8 × 8) chess board so that every square is guarded (watched) by at least one piece?

Partial solution

Queens

q(8) = 5

Knights

k(8) = 12

Bishops

b(8) = ?

Rooks

r(8) = ?

Note The condition that no piece is guarding any other piece is not part of this problem. It is satisfied by the Queens and Bishops but not by the Knights. What about the Rooks?

Problem III

Extend problems I & II above to a general size of board.

Problem IV

Display the set of all (distinct)∗ solutions graphically (or algebraically if no suitable graphics are available) at each stage in I, II & III above.

(∗Equivalent solutions are related one to another either by a rotation of the board or by reflection in a straight line.)

Problem V

Attempt to construct explicit algebraic formulae for Q(n), q(n), k(n), b(n), or r(n): thereby avoiding the need for the logical analysis used above.

How would the graphical (or algebraic) display be produced if indeed a function value for a given n was known?

Problem VI

Consider the extension of problems I to V to 3D chess.

Readers are invited to send their attempts at some or all of the above problems to Mike Mudge, 'Square Acre', Stourbridge Road, Penn, South Staffordshire WV4 5NF, tel (0902) 892141, to arrive no later than 1 May 1988.

It would be appreciated if such submissions contained a brief summary of results obtained, in a form suitable for publication in *PCW*. These submissions will be judged using subjective criteria, and a prize will be awarded by *PCW* to the 'best' contribution received by the closing date.

Please note that submissions can ony be returned if a stamped addressed envelope is provided.

Review: August '87

This produced an acceptable spectrum of response. There was general agreement that the complete solution of (i) is given by: 55, 66, 666. The solution sequence for (ii) begins 1 4, 19600,74909055 . . . for (iii) 1 210, 40755, 7906276, 1533776805 . . . and for (iv) 1, 40755, 1533776805 . . .

Part (v) is fascinating. Using the notation $t_a \pm t_b = t_c\ t_d$ it is found that:

a 6 18 37 44 86 91 116 132 247 278 392 613 637 662 798 . . .

b 5 14 27 39 65 54 104 125 242 209 374 459 350 275 714 . . .

c 8 23 59 108 106 156 182 346 348 542 766 727 717 1071 1153 . . .

d 3 11 25 20 56 73 51 42 49 183 117 406 532 602 356 . . .

(due to Gareth Suggett).

However, within the spirit of 'Numbers Count' this month's prizewinner is Martin Sann of The Bothy (Home Farm), Firbeck Hall, Firbeck, Nr Worksop, Nottinghamshire, who was attracted to the sequence 1, 36, 1225, 41616, 1413721, 48024900, 1631432881, 55420693056, 1882672131025, 63955431761796, 2172602007770041, 73804512832419600 . . . of square numbers which are also triangular.

Martin was predicting that the 15th number in this sequence would appear on his BBC 'sometime early in the 22nd century' . . . only to discover subsequently that Rev Canon DB Eperson (then of Bishop Otter College, Chichester) in *The Mathematical Gazette* (Vol 47, page 237, 1963) provides a simple algorithm for generating terms of this sequence. The observation of 'Numbers Count' (*PCW*, March 1983) that only five tetrahedral numbers are also triangular is worth repeating together with the result, first proved by GN Watson in 1918, that only three tetrahedral numbers. are also square. What are the numbers referred to in these results?

Mike Mudge welcomes correspondence on any subject within the areas of number theory and other computational mathematics. Particularly welcome are suggestions, either general or specific, for future Numbers Count articles; all letters will be answered in due course.

Isolated readers can be put in contact with others sharing the same interests. However, greater efficiency regarding published problems should result from contacting the prizewinner.