

AN ALICE PUZZLE

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I have been sitting in on an honor's class about Lewis Carroll being taught this spring semester at my old college haunt Butler University in Indianapolis. Among the many new puzzles and games being introduced in the class I offer the following based on the ten different letters in "Alice in Wonderland". These ten are ALICE and DROWN, perhaps referring to the 2nd Wonderland chapter "A Pool of Tears" where Alice thought she might drown in her own tears.

We place these ten letters in pairs on the following 5x5 grid in which every one of the 25 entries is a main definition in Chambers English Dictionary 11th ed. This judicious placement makes the grid a pandiagonal magic square. It is magic since each rook 5-tour of the rows and each rook 5-tour of the columns can be rearranged into the ten letters ALICE-DROWN. Also each of the diagonals, including the broken ones, contains bishop 5-tours that rearrange into the same ten letters. Each of the 25 entries is therefore on two rook tours and two bishop tours. For example EO (a mid 18th century gambling game) is on rook tours AD to WC and EO to NC. The bishop tours are EO-IN-AW-CR-DL and EO-CD-WI-AN-LR.

AD	IN	CO	WE	LR
EO	WL	RA	ID	NC
RI	CD	NE	LO	AW
LN	AO	WI	CR	ED
WC	RE	DL	AN	IO



A Puzzle: Clearly there are at least 20 different arrangements of ALICE-DROWN on the grid. But there are many more. According to "Card Tricks & Puzzles" by "Berkeley" and T. B. Rowland, 1897, London, Geo. Bell and Sons, there are 42 choices of five

entries that yield the magic sum in a pandiagonal magic square. These same 42 can be found in our letter square. Can the reader find them? Hint: Look for perfect St. George's and St. Andrews crosses on the grid.

Some Mathematics: The grid can be easily constructed by using chess knight 5-tours. For instance use each of the letters in ALICE and trace an A-tour, L-tour, etc. Then do the same for DROWN. Notice that for the center N and E the tours fan out. Mathematicians will notice that if we add the 10 knight tours to the 20 rook and bishop tours we obtain for the 25 "points" (the entries) the structure of a finite affine geometry.

To convert to a number square set A-L-I-C-E equal respectively to 0-1-2-3-4 and D-R-O-W-N equal to 0-5-10-15-20 and add the two numerical entries. This will result in a square from 0 to 24 with magic sum 60. This is equivalent to regarding the letters as being in base 5 arithmetic.

The Butler class text is, naturally, Martin Gardner's *The Annotated Alice, The Definitive Edition*, 2000, Norton.

The ALICE GAME: Make a copy of the blank 5x5 grid (or use a corner of a checkerboard) and cut out the 25 ALICE-DROWN pieces. Mix the pieces face-down and each of two players draws 10 tokens. They will alternately place a token on the 5x5 board under one of the following two rules.

- (1) No two pieces may have a letter in common in any row or column.
- (2) (Cut-throat) Same as (1) but in addition, no two pieces may have a letter in common in any diagonal, broken or not.

In either case, players can draw from the five remaining pieces in the "kitty" if they cannot place one of their own. The onus is always on the second player to note misplays by the first player. The last player to be able to play wins.

You can use 25 dominoes from a double nine set as playing pieces if you wish. For example, pair each of blank, 1, 2, 3, 4 with each of 5, 6, 7, 8, 9.

