MORE SLIDING-LETTER PUZZLES

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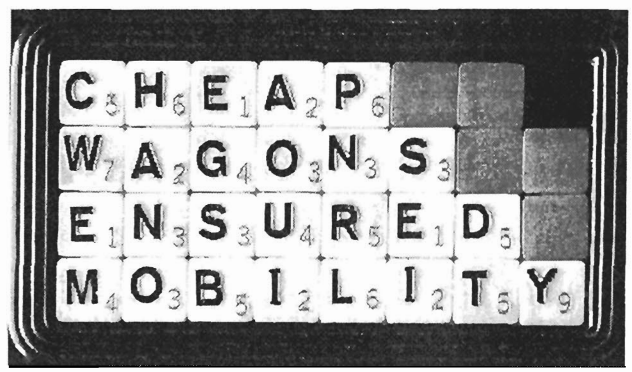
Since writing "Vintage Plastic Sliding-Letter Puzzles" (WW, Nov. 2011, p. 310) I have discovered some additional puzzles of this kind manufactured by various companies during the 1960's and 1970's - and one of recent vintage that is still in print. In this article I will describe these puzzles and discuss some of the logological problems suggested by them.

First, some definitions. Given a rectangular grid of squares where each square either contains a letter or is a black square (as in a crossword puzzle), a *string* is a group of horizontally or vertically contiguous letter squares that is immediately preceded and succeeded by either an edge of the grid or a black square. An *n-crossword* is a grid in which all strings are at least *n* letters long and every string of two or more letters is a valid English word. Throughout this article I will use the TWL06 North American Scrabble word list as the arbiter of valid words.

SKOR



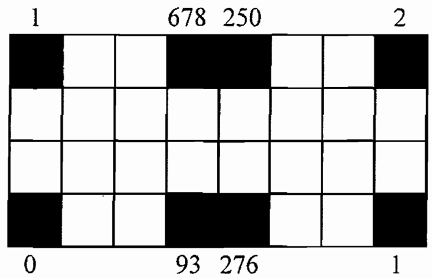
Our first puzzle, shown in the picture to the right, is called SKOR and was manufactured by Wm. F. Drueke & Sons, a well-known game manufacturer, in the 1960's. As usual, I do not know how the tiles were arranged when this puzzle was originally sold, so I have arranged them to make a snowball sentence. This puzzle has exactly the same structure as the Roalex "Scribe-O" discussed in my previous article, having 26 letters, 5 blank red-colored tiles, and an empty space in an 8x4 grid. However, there are several differences between SKOR and Scribe-O:

(1) The letter distribution in SKOR is different from, and better than, Scribe-O.

(2) The letter point values differ from those in Scribe-O, and have the pleasing feature of summing to exactly 100 (versus Scribe-O's 97). These values are A=2, B=5, C=5, D=5, E=1, G=4, H=6, I=2, L=6, M=4, N=3, O=3, P=6, R=5, S=3, T=5, U=4, W=7, Y=9.

In addition, the rules printed on the back of SKOR propose a different kind of puzzle. Instead of making crosswords containing six black squares (the five red tiles and the blank space), as in Scribe-O, the maker of this puzzle challenges solvers to make crosswords using *all* of the SKOR tiles, with the five red tiles to be treated as wild-card letters (like the blank tiles in Scrabble). .

To achieve an optimal score of 200 points it is necessary for the grid to be at least a 2-crossword. This means that the empty space (the sole black square in the crossword) must lie in the top or bottom row, for if it lies in the second or third row there will be a one-letter vertical string. If we put the black square in one of these eight locations



then it will satisfy the stronger requirement of being a 3-crossword.

An exhaustive search by computer of these eight options finds a total of 1301 200-point 3-crosswords. The numbers in the diagram above show how many solutions there are for each location of the black square. Here is one solution for each case (except for the bottom-left case, for which no solutions exist). The grey squares in each grid represent the five wild-card tiles.

■	C	H	A	M	A	D	E
R	O	U	T	E	M	E	N
U	N	B	O	W	I	N	G
M	I	S	P	L	A	Y	S

C	A	D	■	H	O	W	L
U	R	O	P	Y	G	I	A
R	E	G	I	M	E	N	T
B	A	S	E	N	E	S	S

A	C	Y	L	■	P	U	B
R	H	E	O	B	A	S	E
M	O	T	I	O	N	E	D
S	W	I	N	G	E	R	S

S	H	A	D	O	W	S	■
C	E	N	O	B	I	T	E
O	R	I	G	A	N	U	M
P	O	L	Y	S	O	M	E

S	W	A	Y	A	B	L	E
P	I	C	O	G	R	A	M
I	N	H	U	M	A	N	E
T	O	E	■	A	D	D	S

L	I	P	O	S	O	M	E
U	N	A	B	A	T	E	D
S	C	R	E	W	I	N	G
T	H	E	Y	■	C	U	E

B	E	S	H	A	D	O	W
I	M	P	O	L	I	C	Y
R	E	I	N	S	M	A	N
O	U	T	G	O	E	S	■

Seven letters of the alphabet (F, J, K, Q, V, X, and Z) are not found among the SKOR tiles. Is it possible for each of these to appear in a 200-point solution as a wild-card letter? Except for Q the answer is "yes" and all of these can be 3-crosswords, as shown below (grids on the top row include F, J, K wild cards, bottom row grids have V, X, Z). However, it is not possible to incorporate a Q even if 2-crosswords and 1-crosswords are allowed.

S	H	O	W	■	B	U	M
L	A	P	I	D	A	R	Y
O	L	E	F	I	N	I	C
G	E	N	E	T	I	C	S

C	A	W	■	J	I	N	N
O	L	I	G	U	R	I	A
S	O	M	E	B	O	D	Y
H	E	P	T	A	N	E	S

A	C	T	A	■	T	O	O
C	H	I	P	M	U	N	K
R	I	N	S	A	B	L	E
E	D	G	E	W	A	Y	S

C	L	A	D	■	G	A	Y
H	O	M	I	N	I	N	E
U	N	P	R	O	V	E	N
B	E	S	T	R	E	W	S

W	E	B	■	D	O	P	Y
E	X	O	N	U	M	I	A
R	E	L	A	C	I	N	G
E	S	T	H	E	T	E	S

P	I	S	H	■	C	A	B
U	N	W	E	I	L	D	Y
S	T	A	R	G	A	Z	E
S	O	M	E	O	N	E	S

Since SKOR has the same layout as the Scribe-O puzzle, an obvious challenge is to construct 200-point crosswords with SKOR using the Scribe-O rules, in which the blank tiles are treated as black squares rather than wildcards. With the extra requirement of being a 3-crossword applied, an exhaustive search finds 299 such solutions, as opposed to the 69 possible with Scribe-O. Here are three of the 299 solutions:

B	I	T	S		M	O	P
A	C	A	U	L	I	N	E
H	Y	D	R	O	G	E	N
		S	E	W			

M	A	P		W	H	O	A
I	C	E	B	O	U	N	D
S	Y	R	I	N	G	E	S
	L	E	T				

A	T	E			W	E	B
D	I	A	P	H	O	N	Y
S	C	R	O	U	N	G	E
	S	L	I	M			

With a bit of searching I eventually managed to obtain two physical SKOR puzzles. Placing one above the other produces an 8x8 grid in which the upper 8x4 and lower 8x4 can be arranged independently. This suggests an obvious challenge: make this 8x8 into a 3-crossword with the 12 black squares (represented by the 10 red tiles and the two blank spaces) arranged to have 180° rotational symmetry, as is traditional in a crossword.

Below is an example - presented as a puzzle with clues - of a solution to this challenge. This example satisfies all of the above requirements plus two more: the black-square pattern has 90° rotational symmetry, and almost every answer is a common, everyday word.

Across

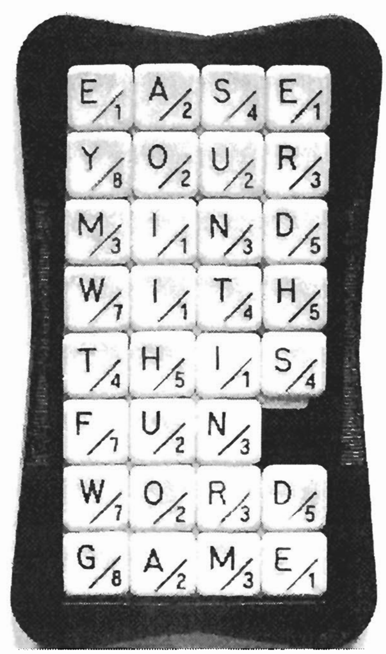
1. She's a real ___
4. Put in overhead bin
8. Ancestor
9. Descendent
10. Noise
11. Merely
12. Underwater gear
14. Moral
18. Trait carrier
21. Much ___
22. Eastern ruler
23. Was on top
24. British bars
25. Sneaky

1	2	3		4	5	6	7
8				9			
10				11			
12			13				
			14		15	16	17
18	19	20			21		
22					23		
24					25		

Down

1. "Yikes!", formerly
2. Long poem
3. Dinner reading
4. Piglet
5. ___ Thousand Villages
6. Lubricant
7. Type of humor
13. Ale, stout, lager, ...
15. Goes with hems
16. Statuesque worshipee?
17. Biblical animal
18. We mind this on the tube
19. Ostrich cousin
20. Pen part

Archer Plastics (ca. 1960's)



This puzzle, shown to the right, was made by Archer Plastics of Bronx, New York, who also made a numerical version of the same puzzle with the tiles labelled 1 through 31. Like Scribe-O and SKOR the letters are given point values: A=2, D=5, E=1, F=7, G=8, H=5, I=1, M=3, N=3, O=2, R=3, S=4, T=4, U=2, W=7, Y=8. The point values on all the tiles add up to 109.

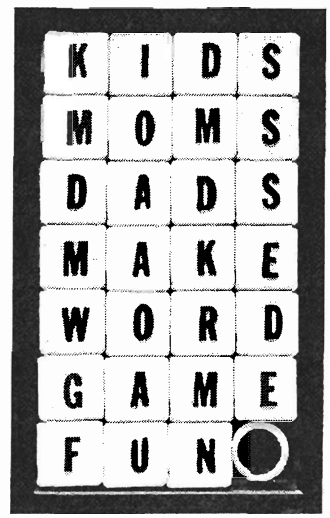
I do not know how the letters were originally arranged, having only seen two actual copies of this puzzle (both of which were scrambled); the self-referential message shown in the picture is my own discovery. The letter distribution and vowel density (42%) are good, so this puzzle is amenable to many kinds of wordplay. It is easy, for instance, to make one word per column (e.g., DAUGHTER MOTORWAY SUNSHINE MIDWIFE). A much more interesting question is: what's the highest-scoring crossword that can be constructed?

For a crossword to score the maximum of 2 x 109 = 218 points, the black square be in the first or last column and not in the second or seventh row of its column. A computer search quickly shows that such a crossword cannot be made using the Scrabble words, hence the best possible score is less than 218. But how should a crossword be scored in which some of horizontal or vertical strings are not valid words? A natural answer seems to be: each valid word scores the sum of its letter values and each invalid word scores zero.

T	F	W	R
U	U	E	E
I	M	I	D
S	I	G	H
	T	H	E
N	O	M	A
O	R	A	D
W	Y	N	S

The provably highest-scoring crossword is not known; my best attempt is shown to the left. Every horizontal and vertical word is a valid Scrabble word except for the two shaded rows, which cause 27 to be deducted from the maximum of 218 for a total score of 191. Can this be bettered?

Kids/Moms/Dads Puzzle (unknown manufacturer, ca. 1960's)



Although I do not know much of the history behind this puzzle, I do know that it was sold with its letters arranged as shown in the picture to the right. The message may be pleasing but the letter distribution is dreadful - there are no T's or H's, for example, and too many D's, M's, and K's. Still, what's logology without a good challenge?

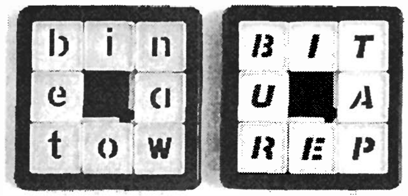
Can you arrange the tiles to make a word in every column? This is a hard problem, as there are just 243 ways to do it using the Scrabble words. Here are three of them presented as clued puzzles.

_ _ _ _ _ _ _ Removed cream from
_ _ _ _ _ _ _ Sandwich Mr. Bumstead likes
_ _ _ _ _ _ _ Penetrates disguise
_ _ _ _ _ _ Tilled the land

_ _ _ _ _ _ _ Tussaud, Bovary, et al.
_ _ _ _ _ _ _ Kingdom of the Blue Devils?
_ _ _ _ _ _ _ _____ gun: evidence
_ _ _ _ _ _ Makes it look tiny by comparison

_ _ _ _ _ _ _ Fabrics of Damascus
_ _ _ _ _ _ _ Lumberjack, e.g.
_ _ _ _ _ _ _ Swimming pool component
_ _ _ _ _ _ Cheated by miscounting chocolate?

R & L Cereal Premiums (Rosenhain & Lipmann Co., Australia, 1974)



These little puzzles, mere 3x3's, were made by the R & L Co. of Melbourne, Australia and given away inside boxes of cereal. The puzzle frames and pieces come separately and require assembly, which means that each puzzle can be put together in either parity (from which only half of the tile arrangements can be achieved by sliding the tiles). On the other hand, they can be taken apart and reassembled at any time, so for the purpose of the following puzzles we will ignore parity issues. In other words, "cheating" by taking the tiles out and putting them back in is permitted.

These puzzles are so small that it's fairly easy to enumerate all the solutions to a given puzzle by hand. For example, there are 17 2-crosswords which can be made with the lowercase puzzle and 10 with the uppercase one. Can you find all 27 of these? Note that two grids which are transposes of each other are not considered distinct. For reference, the 2-letter and 3-letter words in TWL can be found at *wordsolver.net/?tpl=twl2* and *wordsolver.net/?tpl=twl3*. See Answers and Solutions for the answer.

Here's another fun problem. Place the two puzzles next to each other (in either order) and arrange the tiles so that the whole 6x3 makes a crossword puzzle. What is the highest-order *n*-crossword that can be made using Scrabble words? Below is the unique answer, a 1-crossword (a 2-crossword or higher is not possible) with the smallest possible number of unchecked letters, one. The uppercase 3x3 is on the left.

U	P		B	O	W
R	E	T	I	N	A
B	A	I	T		E

I Spy Word Scramble (Briar Patch, 1994)

This puzzle, pictured to the right, first appeared in 1994 and is still in print. It sets several records, having the largest number of tiles (48) of any sliding-letter puzzle I am aware of as well as the largest physical tiles, with the entire puzzle including frame measuring eight inches square.

It is marketed as an educational children's game, so the rules given with the puzzle are simple, merely requiring the player to form words one at a time within a given time limit. These rules explain to some degree the unusual letter distribution that's nearly a double pangram, differing from one only by having an extra E and just one J, Q, V, W, and X.

Despite the difficult letter distribution there are still some interesting logological problems which can be posed using this puzzle.

One hard challenge is simply to arrange the tiles to spell one word per line. This is difficult not just because of the generally bad letter distribution but also because there are only 13 vowels (compared to the 19 or 20 which would be expected in 48 letters of typical English). At first glance it was not even clear whether there would be a solution, so I turned the problem over to computer attack.

The unrestricted search space is very large, so to make it more tractable I added a few reasonable restrictions. Putting the six-letter word on the first row, I decreed that there would be (1,2,2,2,2,2,2) vowels on the successive rows and that J, Q, X, and ZZ would be located one each, in some order, in the four words on the first four rows. Given these assumptions I found about 1000 solutions; three of the nicer ones are shown below.

F	J	O	R	D	S	
Q	W	E	R	T	Y	S
F	L	U	M	M	O	X
B	U	Z	Z	I	N	G
B	A	L	K	I	N	G
C	H	A	P	P	E	D
K	V	E	T	C	H	Y

T	R	A	N	Q	S	
C	O	M	P	L	E	X
J	U	M	P	O	F	F
D	R	I	Z	Z	L	Y
B	E	D	B	U	G	S
H	A	W	K	I	N	G
K	V	E	T	C	H	Y

S	P	H	I	N	X	
Q	W	E	R	T	Y	S
J	U	M	P	O	F	F
G	U	Z	Z	L	E	D
L	A	C	K	I	N	G
B	O	M	B	A	R	D
K	V	E	T	C	H	Y

There are also solutions with other vowel patterns, such as VEXING QWERTYS JUMPOFF BUZZARD KNIGHTS CHOMPED BLACKLY, with pattern (2,2,2,2,1,2,2).

Here is an even harder challenge. Paint over L of the letter tiles to change them into black squares, then arrange all the tiles to make a 1-crossword. This is not even close to possible for L=0, so the question is: how small can L be? Here is a solution with L=9:

B	U	T	Y	R	A	L
U	N	R	E	A	D	Y
G	L	O	W	S	X	M
G	I	P	Q	Z	Z	P
E	V	I	C	T	B	H
D	E	N	K	H	M	K
	J	S	C	O	F	F

Does a solution exist with a smaller value of L? This is an open problem.

Summary and Conclusions

In this pair of articles we have discussed eleven different sliding-letter puzzles that have been manufactured and sold during the last fifty years. One way to measure the richness of a sliding-letter puzzle for wordplay by determining the order *n* of the highest-order *n*-crosswords which can be formed with it, and counting the quantity, *q*, of the distinct *n*-crosswords that exist. We also define a "0-crossword" to be a set of words filling the long dimension of a puzzle, one per row or column, with the strings in the other dimension being arbitrary. In the following table, the values of *q* and *n* are shown in the last column, and the eleven puzzles are ordered from best to worst, sorting by *n* first and then *q*:

Puzzle	Size	#letters	#blanks*	Letters	Best Grids
SKOR	8x4	26	5	AABCDEEEGHIILMNNOOPR SSTUWY	299 3-crosswords†
Scribe-O	8x4	26	5	AAAACDDEEGHILMNNOOPR STUWYY	69 3-crosswords†
Rate Your Mind Pal	4x4	15	0	AADEILMNOPRRTUY	24 3-crosswords
Cornell Crossword	4x7	25	2	AAACEEGIIIKLLMNOOOPR RRRRT	50 2-crosswords
Lowercase R&L	3x3	8	0	ABEINOTW	17 2-crosswords
Uppercase R&L	3x3	8	0	ABEIPRTU	10 2-crosswords
Lingo	14x4	45	10	AAAAAABBCCDDEFGGHIIL LLMMMNNOOOOOPPRRSSSS TTTWY	numerous 1-crosswords
Archer Plastics	4x8	31	0	AADDEEEFGHHIIIMMNNOO RRSSTTUUWWY	1,000,000's of 0-crosswords
Ro-Let	4x4	15	0	ABDEGHIMORSTUWY	241677 0-crosswords
I Spy Word Scramble	7x7	48	0	AABBCCDDEEEFFGGHHIIJ KKLLMMNNOOPPQRRSSTTU UVWXYYZZ	1000's of 0-crosswords
Kids/Moms/Dads	4x7	27	0	AAADDDDEEFGIKKMMMMNO ORSSSUW	243 0-crosswords

(* the number of blank tiles in the puzzle, not counting the blank space which is also present)
(† using the five blank tiles as actual blanks, not wildcard letters)

This ordering matches our experiences with these puzzles fairly well. SKOR and Scribe-O offer the most flexibility due to their five blank tiles and good letter distributions, whereas I Spy Word Scramble and Kids/Moms/Dads are the most limited due to their difficult letter sets. I would probably put the R&L puzzles at the very bottom because of their small size, but otherwise this ordering captures each puzzle's capability for wordplay fairly well.