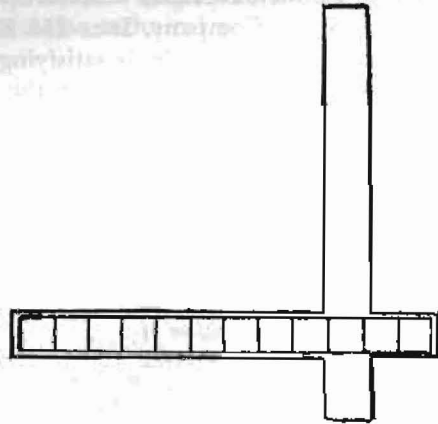


Dudeney's Switch Puzzle

This is the tale of a quasi-mechanical word puzzle propounded by Sam Loyd, a famous British puzzler, to Henry Ernest Dudeney, another famous British puzzler, around the turn of the century. Dudeney is best known for his work in the field of mathematical recreations, but he was also interested in word curiosities, and the Switch Puzzle is one of the many included in his book, *The World's Best Word Puzzles*, published by the "Daily News" Publications Department, London, 1925.

Examine the diagram at the right. It is a four-armed box, somewhat resembling a railway switch, containing twelve movable blocks. The long arms will just hold nine blocks and the short arms two blocks, with room for one more at the crossing. Select a word of twelve letters, and place one letter on each of the blocks, so that the word will read correctly from left to right. Then, in the fewest possible moves, slide the blocks into the other arms of the box, so that the word will read correctly from the top to the bottom of the box. A "move" is the sliding of one letter any distance within the box, whether you



turn a corner or not. Of course, the blocks may not be taken out of the box, so that "leaping" moves are not possible. First select your word—an important point—and then find the fewest possible moves to readjust it within the box.

A solution to this problem in the fewest possible moves depends entirely on the selection of the most accommodating word. Apart from this word condition, the blocks themselves can be shifted from horizontal to vertical order in a minimum of twelve moves. If we write the word INTERPRETING onto the blocks in their

horizontal position, we discover that we can shift the word into the desired vertical position in that minimum of twelve moves, and we know that the INTERPRETING solution cannot be beaten.

This is the point to which Dudeney carried his analysis of the problem. He commented that he knew of no other word transferable from horizontal to vertical position in only twelve moves.

Is INTERPRETING the only word permitting a perfect solution of the Switch Puzzle? If not, how do we go about looking for other words of the sort? Why limit ourselves to a box in which the horizontal and vertical word paths intersect on the ninth letter? It is obviously possible to make the paths intersect on any of the twelve letters, from first to last. What happens to the problem if we shift the intersection point?

A conspicuous feature of the word INTERPRETING is the sequence of seven letters in it constituting a palindrome, reading the same backward as forward: TERPRET. Thinking about this feature, we realize that if the horizontal and vertical paths in the box intersected either on the first or on the last letter, a twelve-letter palindrome would provide an ideal solution to the altered problem. There are very few such palindromes in English, however. The only genuine one that we have been able to locate is a hyphenated word, KINNIK-KINNIK, a variant spelling of "kinnikinnik," the name of a mixture of bark, dried leaves, and sometimes tobacco, formerly smoked by the Indians and pioneers in the Ohio valley. The spelling KINNIK-KINNIK is given in the *Handbook of American Indians North of Mexico*, edited by Frederick Webb Hodge, published by Rowman and Littlefield, Inc., New York, 1965.

In addition to KINNIK-KINNIK, there is ADAVEN, NEVADA, a community in Nye County, Nevada, west-northwest of Pioche. There is also the SINRAM-MARNIS Oil Company, Inc., 255 Exterior Street, The Bronx, New York. Yet, none of these is a genuinely satisfying solution.

If we move the point at which the horizontal and vertical paths in our box intersect to the eleventh letter, and apply the palindromic principle again, we find two words that produce ideal solutions: SENSUOUSNESS and LEVITATIVELY. Each of these words consists of a palindromic sequence of eleven letters, followed by an extraneous twelfth letter.

We have now made a most illogical discovery, brought out by the following tabulation:

<i>Position of Intersected Letter</i>	<i>Number of Letters in Palindromic Sequence</i>
12th	12
11th	11
10th	7

The progression from 12 to 11 to 7 is abnormal, and cannot be accounted for in any simple fashion.

Stymied in our thinking about the problem, we turned for advice to Mr. Howard W. Bergerson of Sweet Home, Oregon. In time, Mr. Bergerson provided the following explanation:

"I believe that I see the underlying theoretical reason for the irregular progression 12-11-7 in the Switch Puzzle. To explain it, I shall use hypothetical words for illustrative purposes. Since a problem like this, upon study, may manifest unexpected subtleties, one would be brash to offer *necessary* conditions for the formation of 'ideal' words too quickly. I shall, therefore, concern myself only with what appear to me to be the simplest *sufficient* conditions.

"Observation No. 1: Palindromic letter sequences on either side of the intersection letter may move either up or down without changing their order.

"Observation No. 2: Parallel sets of letters—two identical sequences, one to the left and the other to the right of the intersection letter—will keep their order unchanged only if the left-hand sequence moves *down* and the right-hand sequence moves *up*.

"The *simplest* sufficient rules for the formation of a word that will be transferable from horizontal to vertical are that the letter in the intersection square, plus all letters either to the right or to the left of it, as the case may be, must be matched by the same letters, in the same order, appearing at the beginning or at the end, as the case may be, of the word; and that any letters lying between these parallel sets or sequences must form a palindromic group.

"The foregoing may be illustrated by the hypothetical word PARKNOON-PARK, with the ninth letter (the second P in the word) being the intersection letter.

"In the extreme case in which the intersection letter is either the first or the last letter of the word, as it is in the case of KINNIK-KINNIK, the rules set forth above oblige us to regard the first and last letters as parallel sets or sequences (which, technically, they are), and the ten letters in between as a palindromic group (which they do, technically, constitute); but the single letters at each end of the word that make up the parallel sets are also technical palindromes, identical with one another.

"The two K's, then, as two identical palindromes, increase what would in any ordinary case remain a ten-letter palindromic group, converting it into a twelve-letter palindrome. However, if we preserve the distinctions imposed by the previously enunciated rules, the two K's remain parallel sets separate from the palindromic group that lies between them, and the first number in the progression 12-11-7 is really 10, *not* 12.

"Now, let us take the case of the intersection letter in eleventh position. Adhering to the 'simplest sufficient' rules, any 'ideal' word must begin and end with identical two-letter combinations, exhibiting the pattern AB.....AB. This means that the intermediate palindromic group will be reduced by two letters, not by one; from 10 letters to 8 letters, making the complete word pattern ABWXYZZYXWAB. Obviously, the complete numerical progression, instead of beginning as 12-11-7, will be 10-8-6-4-2-0. The 'simplest sufficient' rules do not permit the formation of words such as SENSUOUSNESS, LEVITATIVELY, or INTERPRETING.

"These other words fall into an entirely different sequence formed by the following somewhat more complex 'sufficient' rule: on one side of the intersection square—the left side, let us say—there is a set of letters 'S' followed by a palindromic group, followed by a repetition of the set "S" with the first letter of the second set "S"

being placed in the intersection square, followed by another and probably different palindromic group.

"The foregoing may be illustrated by the hypothetical word WINGAGWIN-PUP, with the seventh letter (the second W in the word) being the intersection letter.

"Under this rule, the word SENSUOUSNESS (and also the word LEVITATIVELY) is the extreme, limiting case, divided into four sections as follows: S-SENSUOUSNE-S-S. The first and the third sections, each occupied by a single S, are the parallel, identical, nonpalindromic sets 'S' referred to in the new rule, and the second and fourth sections, ENSUOUSNE and S, are the nonidentical, palindromic groups referred to in the rule. The intersection letter is the first and only letter of the third, nonpalindromic, letter sequence. Because this is a limiting case, the ordinarily nonpalindromic first and third groups, consisting of one letter each, become one-letter palindromes, and create the appearance of changing the palindromic nine-letter second group into a palindromic eleven-letter group, but this is appearance only, not reality.

"In like manner, the word INTERPRETING must be broken down into four sections as follows: IN-TERPRET-IN-G. The first and third sections, each occupied by the combination IN, are the parallel, identical, nonpalindromic sets 'S' referred to in the new rule, and the second and fourth sections, TERPRET and G, are the nonidentical, palindromic groups referred to in the rule.

"It follows from these considerations that the complete numerical progression for words based on the more complex rule is 9-7-5-3-1, rather than beginning 12-11-7.

"We can now see that the irregularity of the sequence that appeared to begin 12-11-7 is the result of two factors: (a) the mixing of two unrelated sequences, and (b) false appearances created by the fact that parallel sets of letters, normally nonpalindromic, become identical palindromes in limiting cases where they are single letters, augmenting the genuine palindromic group lying between them."

Brilliant! Now, dear reader, all that remains for you to do is to find actual words that exemplify each possible case under both of the rules. After you have succeeded in doing so, you may go on to consider whether there are still more complex "sufficient" rules under which words can qualify as ideal solutions to the Switch Puzzle, exemplifying them fully if you do hit upon additional "sufficient" rules.

Beyond that, you may feel inspired to tackle words of other lengths: 8-, 10-, 14-, and 16-letter words, for instance. Nor must you necessarily limit yourself to words spelled with an even number of letters; you may find totally different rules applicable to words consisting of odd numbers of letters.

There is evidently a great deal of research remaining to be done on Dudeney's Switch Puzzle, and we hope that we have inspired you to try your hand at it.