THEMATIC KNIGHT'S TOUR QUOTES

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Knight's Tour Quotes (KTQs), also called Knight's Tour Crypts, are a word puzzle enjoying a new vogue in the National Puzzlers' League since David Silverman reintroduced them in 1973. Dmitri Borgmann presented some examples in "Chesswords" in the May 1974 Word Ways. A KTQ is a quote written out along a knight's tour. It is a form, usually rectangular, with each square containing a single letter or punctuation mark. Stepping from letter to letter by knight's moves (two squares horizontally or vertically, then one square perpendicular to that), visiting all letters once, one can spell out a message. To reduce the task from drudgery to pleasure, the starting letter is underlined and the word lengths and punctuation of the message are giv-AAEE. ENR RDVNEASN en. A small example ("Even paranoids can have real enemies." 493447) is CHOAVIAE IESMNLPE given at the right.

KTQs are fun to solve, but they are trivial to compose. Simply take a knight's tour from a book and replace the numbers in order with the characters of the quote. If none is available, one can very easily be constructed. The simplest way is to use Warnsdorf's rule: always move the knight to the cell from which there are the fewest exits to unoccupied cells. If there is a choice, it can generally be made at random, except sometimes near the end of the tour. (It may seem odd to always minimize one's choices, but this rule avoids the commonest error in constructing tours: absent-mindedly blocking all approaches to a square.)

To add interest, and to challenge the constructor, I suggest adding the requirement that a line of the array spell out a word or words. Among other things, this can be used to produce personalized puzzles. I once sent a newlywed couple, both in the National Puzzlers' League, a wedding card on which an epithalamial jingle was turned into a KTQ spelling out their NPL pseudonyms.

It is easy to blunder in producing a thematic TKQ; it took me hours to do my first few. I therefore show how to construct one, so that those interested will not have to reinvent the wheel.

Step 1 Get a sheet of graph paper and a pencil with a good eraser.

<u>Step 2</u> Given the word that will appear in the final KTQ, you must choose or write a quotation that includes the needed letters, properly

placed. For the words I will use WORD WAYS; for the quote, this joke from Son of Giant Sea Tortoise, edited by Mary Ann Madden: Why did the chicken cross the road? Because he was giving it the last rites. This contains 62 letters (60 if we omit punctuation marks), which will not make a suitable rectangle (the easiest shape for knight's tours). We want one side to be eight letters to accommodate WORD WAYS. So change "giving it the" to "administering"; the resulting 64 letters make a good eight-by-eight square.

Step 3 In making the tour, it is far too confusing to work with the letters: there are duplications, it is hard to recall what comes next, and so on. So number the characters of the quote in sequence, and use the numbers. The easiest way is to write the letters in ten columns on the graph paper. 0 1 2 3 4 5 6 7 8 9 W H Y D I D T H E 10 C H I C K E N C R O 20 S S T H E R O A D ? 30 B E C A U S E H E W 40 A S A DM I N I S T 50 E R I N G L A S T R 60 I T E S .

Step 4 A knight always move from a white square to a black one, and vice versa. In a tour on a checkerboard, therefore, all white squares will have even numbers and all black squares odd numbers, or vice versa. Thus, in WORD WAYS, the W, R, W, Y will have to occupy odd-numbered positions in the quote and O, D, A, S even-numbered positions, or vice versa. To choose the proper letters from the quote, make a table of each letter's appearances in the quote, separated into odd and even. From the table given below, it is clear that W R W Y

Letter	W	0	R	D	W	А	Y	S
Even	-	26	18	4,6,28	-	40,42,56	-	20,48
Odd	1,39	19	25,51,59	43	1,39	27,33	3	21,35,41,57,63

will have to be odd; there is no choice for W W Y. An otherwise suitable quote may have to be discarded at this stage if the no-choice letters conflict.

<u>Step 5</u> Insert numerical equivalents for the letters into the array. For reasons that become clear in Step 9, they must be inserted along an edge, or the task becomes too difficult. For reference purposes, label the squares of the eight-by-eight as follows: rows are 1 to 8 from bottom to top, columns are a to h from left to right, and a square is labeled by its column and row. Thus, the lower right hand corner is h1. We will insert WORD WAYS into al-h1. (On a rectangle with an odd number of squares, like a seven-by-nine, all corner squares must contain odd numbers -- remember this at Step 4.)

3 (Y) must go in gl, 26 (O) in bl. 1 (the first W) must be two knight moves away from 3, so it must go in el, and 39 (the other W) in al. For the other letters there is a choice of numbers. The best policy is to bunch the numbers up so that they can be connected by a few knight moves. In this case, good bunching is not possible. The best we can do is: 39 26 51 28 1 56 3 48 with four clusters: (1,3), (26,28), 39, and (48,51,56). They will be hard to connect. Now recheck the inserted numbers against the original quote! It is heartbreaking to complete a KTQ and then find it doesn't spell out what it was supposed to.

Step 6 Start connecting the numbers into a knight's tour. Pencil in lines b3-al-c2 and f2-hl-g3 as a reminder that these knight moves must be part of the final tour. Thus only 38 and 40 can go in b3/c2; decide which goes $54 \\ 53 \\ 27 50 55 2 \frac{58}{47} \\ 52 29 \\ 39 26 51 28 1 56 3 48$

54

46 5

where later. 26 and 28 can only be connected by a 27 at c3, so put that in; similarly, 2 must be at f3. 48 can be connected to 51 via f2/d3 or g3/e2; let's try the former. With 49 at f2, 47 must be at g3. Now look at a2. It has access to only 2 squares, c1 and b4. If we're not to cut it off from the tour, we must connect it to c1 (51); put 52 in a2, 53 in b4. Similarly for h2. 53 can now be connected to 56 in only one way. This leaves 28 only one exit, so put 29 at b2.

The first connections are done, and appear in the above array. Now underline all active numbers -- those still lacking at least one connection. Run through the fragments of the tour thus far (1-3, 26-29, 47-58) for errors, and make sure no active number is walled in. Make such checks <u>frequently</u>, or you will make errors, and waste a lot of time.

It looks OK, so save this diagram for reference (in case later mistakes force us to retrace our steps) and copy it elsewhere.

	' Contin				
tered	chains.	In do	ing s	o, th	ere are
three	importar	nt pri:	nciple	es to	follow:

(1) The still-unused squares must always be kept in as neat and rectan-

always be kept in as neat and rectan-
gular a group as possible, to ease later work. Here, the isolated
squares in the second row and the protrusion at $a4/a3/b3$ should be
filled in as soon as possible.

(2) Keep an eye on all active numbers to make sure they are never cut off. If you fill in the next-to-last exit on an active square, like 28 in Step 6, <u>immediately</u> extend its portion of the tour to the last exit, and circle the extension to mark it as a new active number.

(3) Watch for squares with only two exits; new ones will constantly be formed as you go. It is a good idea to mark a two-exit square by pencilling in lines from it to its exits, as was done at the corners in Step 6. Otherwise you will forget, block one off, and have to retrace.

Suppose we connect 39 to 47 first. Observe how 40-44 fill in the second row. Note that placing 42 forces us to extend 3 to 4, and 43 forces extension of this to 5. 38 must go in b3. Now extend the 26-29 and 38-58 chains to smooth out the left side. Now check once again: are all active squares marked and not blocked? Are all chains legal

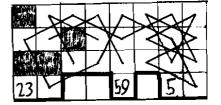
so far? All is well, so save this and copy it over elsewhere.

Step 8 With just a little practice --32 and care -- the above steps go quick-33 ly. We now approach the blood-34 31 sweat-and-tears stage: making the 35 54 59 46 5 23 30 53 24 41 36 43 58 45 last connections in a small remain-25 38 27 50 55 2 47 4 ing area that leaves little maneuvering room. With properly-bunched 52 29 40 37 42 49 44 57 numbers at the start, we should 39 26 51 28 1 56 3 48 reach this stage with only two connections to interweave, but here we have three: 5-23, 30-36, 58-64. The quote was not obliging.

It's hard to juggle three chains in this tight space; it seems best to get one out of the way somehow and put most effort into filling whatever space this leaves. The clear choice is the 30-36 connection. It's short, leaving more room to work with than 5-23 would, and both its ends are constrained. We'd rather save 58-64 for the final crunch, because only the 58 end is tied down; the 64 can stop anywhere.

At this stage, two-exit squares grow thick, and the lines from them spiderweb the edges. In connecting 30 to 36, we can try to keep the remaining area rectangular by hugging the edges, or charge in and remove a few two-exit squares at any cost. Here we try the latter. We also extend 58 to 59 to smooth out the outline.

Step 9 At this stage, I generally draw the outline of the remaining squares separately for greater clarity, and work with that. No numbers are written except the active numbers (to show where connecting chains must attach). Now it's



trial-and-error time. "Well, this is a dead end, but suppose I link this square to this one instead, erase this other link, and draw this new one -- oops, that's a dead end, too".

To put some system in the trials, I generally ignore the connections for awhile and try to link all the unfilled squares in a single closed knight's tour (a closed tour is one in which the start and end squares can be connected by a knight move to form a closed loop). This requires an even number of squares. We have 22 here; otherwise we'd have to backtrack or advance a bit. When the loop is done, choose one active number and try to connect it to another along the tour. In our 5-23 case, we would enter from 23, put a 22 on the tour, and move along it (trying both directions) to 21, 20, 19, ... and hope that, at 6, we would find ourselves a knight's move away from 5. In the present case -- two entry points for 23, three for 5 -- we could expect one or two successes. For each, see if the remaining portion of the loop can serve as a connection for the remaining number(s). If not, tinker with the tour and try again. It may be necessary to go back to Step 8, or even Step 7, and rearrange things a bit. In this case, luckily, the answer comes with a bit less work. At the stage shown, with a closed tour and two left-over three-square chains, I noticed that one of the left-overs could be eliminated by moving from 59 to c6-b8-d7. From there I tried moving to f6 and h5 (Warnsdorf's rule). Could the tour of the remainder be juggled into a route from 5 to 23? It could! I was done in forty minutes, well under par.

Step 10 Run through the whole chain. If it's correct, replace numbers with quote letters, and feel a glow of satisfaction. If not, groan and backtrack.

> 32 61 14 21 18 7 12 CTKSRTIE 9 ETAECCOD 15 22 33 62 13 10 19 6 34 31 60 17 20 63 8 11 UEICSSHH 23 16 35 54 59 46 5 64 HNSGRNI. 30 53 24 41 36 43 58 45 BNESEDTI 25 38 27 50 55 2 47 4 REAELHID 52 29 40 37 42 49 44 57 I?AHATMS 39 26 51 22 1 56 3 48 WORDWAYS

READ READ

In the late 1920s, Allen Walker Read (now professor emeritus of English at Columbia) collected graffiti from the walls of rural outhouses in the western United States and Canada, later employing these as citations to illustrate the usages of various scatalogical and obscene words (in the spirit of the Oxford English Dictionary). His work was privately published in Paris in 1935, in an edition of only 75 copies. In 1977, Maledicta Press (331 S. Greenfield Avenue, Waukesha, WI 53186) reprinted it as <u>Classic American Graffiti</u>, an 83-page paper-back for \$6.00. Scanning Professor Read's several hundred examples, one is struck by how little the words and their usages have changed over the past half-century. Since he was not privy to the inscriptions in outhouses used exclusively by women, his work is necessarily biased; would different emphases have been revealed in those pre-women's-lib days? Despite the gamy nature of his material, Professor Read has written a text of impeccable scholarship and dignity.