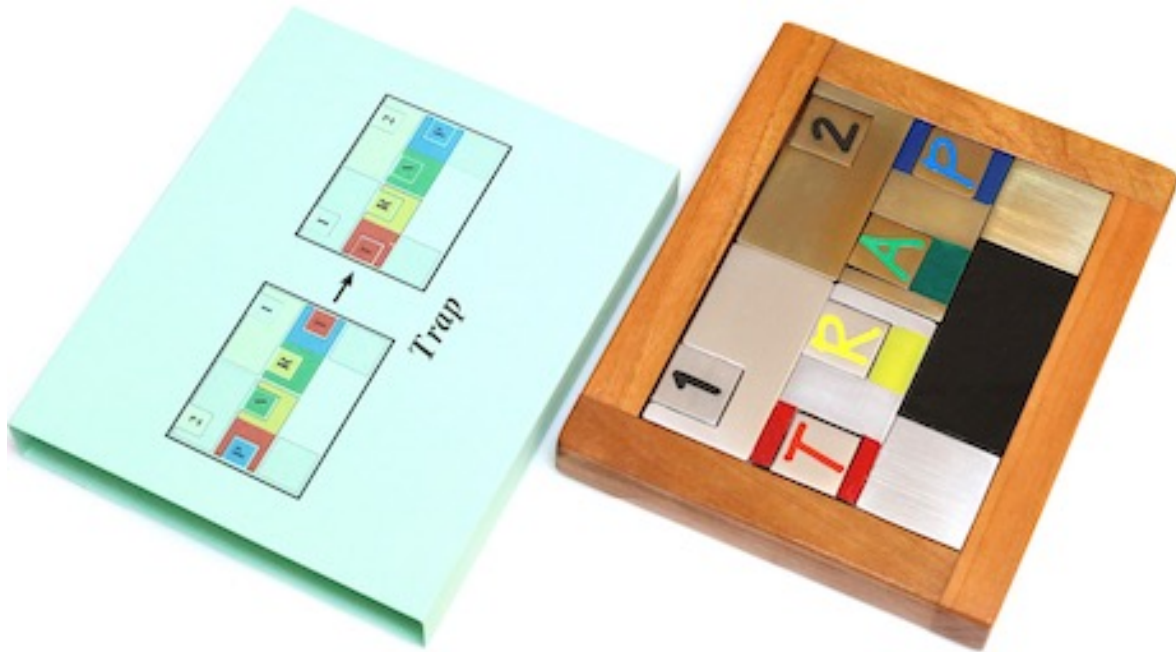
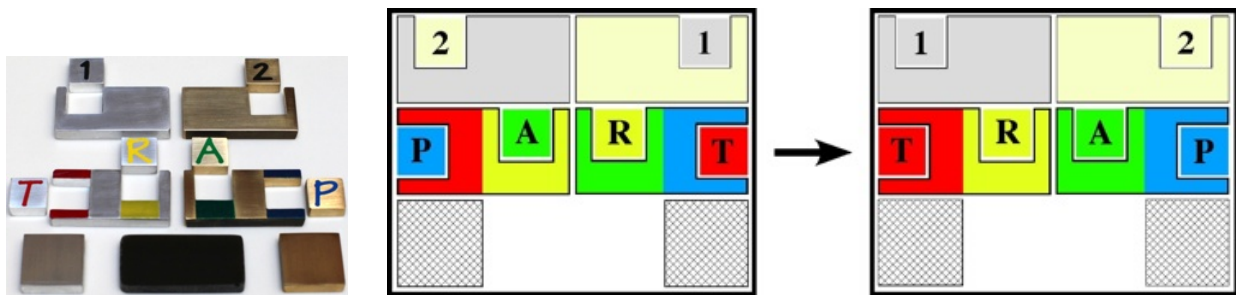


Trap



Designed by Minoru Abe 1986, this one made by J. A. Storer 2007.
 (cardboard sleeve, cherry tray 4" x 5" x 5/8", 12 metal 1/4" thick pieces
 with plexi-glass keeper; left half is aluminum and right half is brass)

There are four 1x2 rectangles, two 1x1 squares, and six little squares labeled **1**, **2**, **P**, **A**, **R**, **T**; each little square is larger than 1/2 unit on a side (so that two little squares cannot pass each other in 1 unit wide opening). The rectangles have receptacles into which a little square can (fit but not a 1x1 square). The goal is to start with it reading **2 1 P A R T** and slide the pieces to make it read **1 2 T R A P**, where the rectangles end up in the same positions as they started (piece coloring is decorative to emphasize the solved state).



Hordern's book gives a solution of 177 rectilinear moves (196 straight-line moves), where a rectangle moving with little square(s) in its receptacle(s) counts as one move. *Baxter's Minoru Abe Gallery* indicates a solution of 174 rectilinear moves (which he has credited to *Jim Henderson*), which can be achieved by a slight modification to Hordern's solution. Those who enjoy this puzzle should also try the *Tricky* puzzle.

Further Reading

Baxter's Abe Gallery, from: <http://www.johnrausch.com/SlidingBlockPuzzles/gallery.htm>

Copyright J. A. Storer

A Commercial Version Of Trap

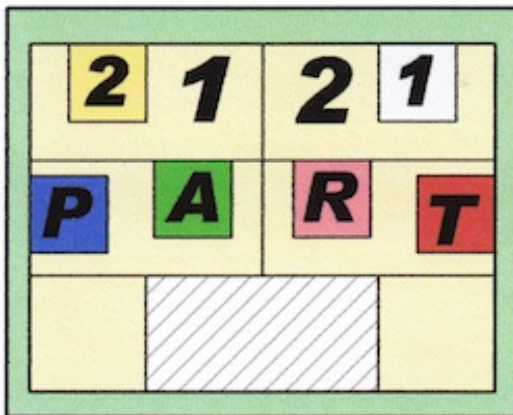


Minoru
Original

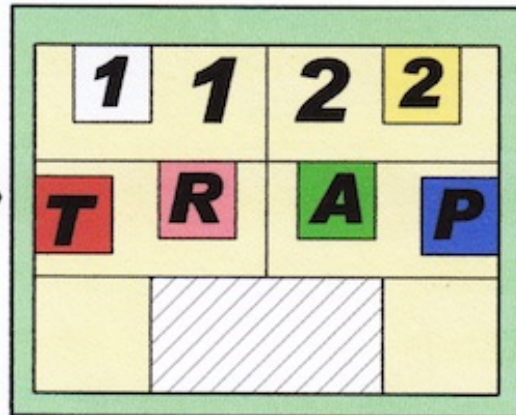
TRAP

始めに【A】のカタチにコマを並べ中央下のコマを取り除いてスタート。空き地を利用してコマを動かし【B】の配置にしてくださいと言うのが問題。ただし移動中にコマを回転させてはいけません。

【A】 Start



【B】 Finish



【なう工房】

〒035-0035 青森県むつ市本町1-1
TEL 0175-22-0652

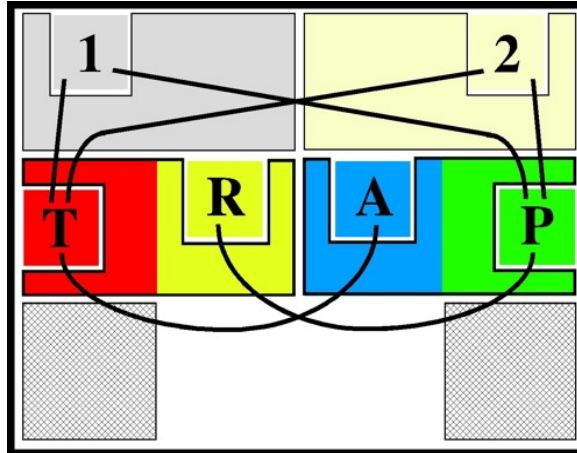
Purchased 2012.

(wood tray and pieces in cardboard box, 5.4" x 6.375" x 7/8")

Copyright J. A. Storer

Hordern's Trap Solution Idea

Hordern first determines the positions that allow one to exchange a pair of little squares, and finds that there are six possible exchanges that can be performed (there are six positions each for performing the $1 \leftrightarrow P$ and $2 \leftrightarrow T$ exchanges, whereas the other four each have a unique position in which they can be performed):



Solving amounts to planning a sequence of exchanges. Hordern finds that nine exchanges are needed, and gives a basic argument that 7 exchanges suffice to get A and R to their correct positions, where some ways of doing this need only two additional exchanges to fully solve the puzzle. He then finds that it takes between 7 and 27 moves to go between any one exchange position and another, notes that there are several orderings for nine exchanges that use a total of 179 moves, and presents this 177 move solution:

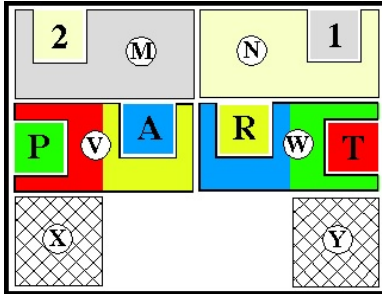
	2	1	P	A	R	T
<i>Exchange 1, R\leftrightarrowP:</i>	2	1	R	A	P	T
<i>Exchange 2, R\leftrightarrow2:</i>	R	1	2	A	P	T
<i>Exchange 3, R\leftrightarrowT:</i>	T	1	2	A	P	R
<i>Exchange 4, R\leftrightarrowA:</i>	T	1	2	R	P	A
<i>Exchange 5, A\leftrightarrow1:</i>	T	A	2	R	P	1
<i>Exchange 6, A\leftrightarrow2:</i>	T	2	A	R	P	1
<i>Exchange 7, A\leftrightarrowP:</i>	T	2	P	R	A	1
<i>Exchange 8, P\leftrightarrowT:</i>	P	2	T	R	A	1
<i>Exchange 9, P\leftrightarrow1:</i>	1	2	T	R	A	P

Partial Capture Moves:

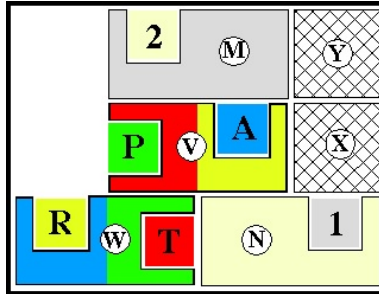
A little square can move (when there is room to move) by placing a finger on it and sliding it. This is also true of rectangle. However, if it is desired that a rectangle move so as to carry along with it the little square(s) it contains, it may be necessary to place a finger on a little square so that pushing it also results in pushing the entire assembly without a little square being left behind. Allowing such *partial capture moves* can save a move.

Hordern's Trap Solution Basic Steps

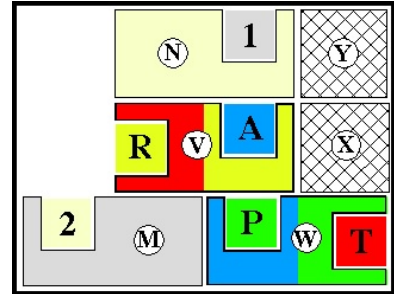
Below are the start position, end position, and each of the nine positions that Hordern's solution visits to exchange a pair of little squares. The larger pieces are labeled M, N, V, W, X, Y.



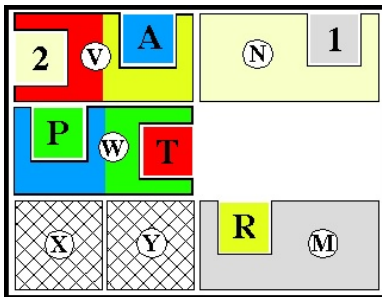
position 0



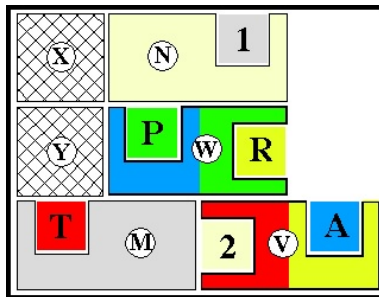
position 16



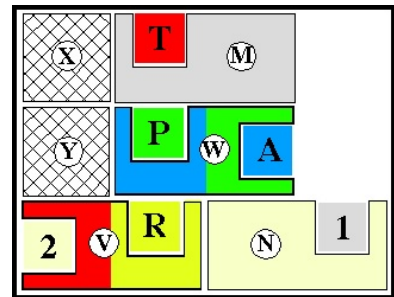
position 39



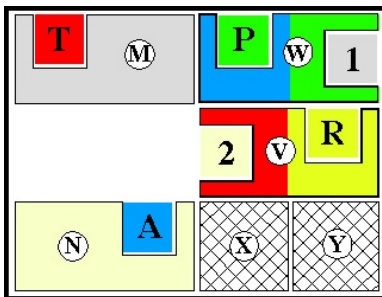
position 54



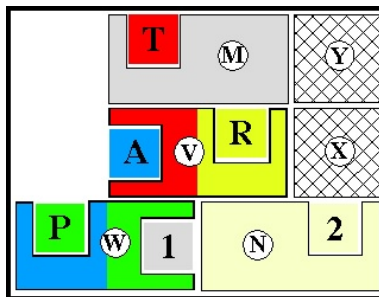
position 71



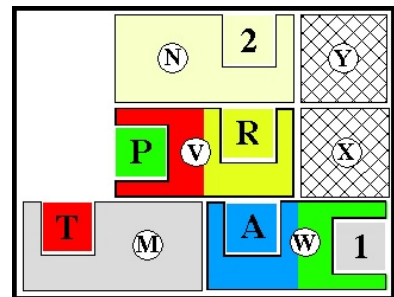
position 94



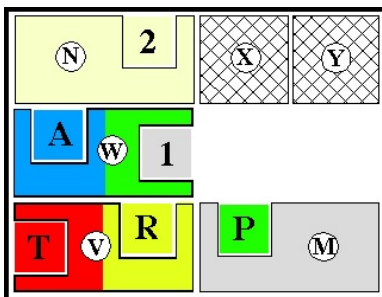
position 109



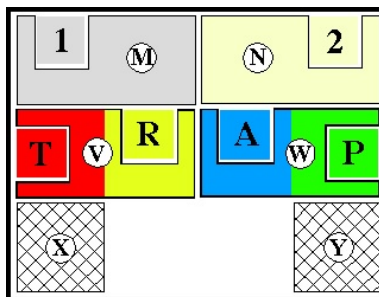
position 126



position 149



position 159



position 177

The Complete 177 Move Hordern Trap Solution

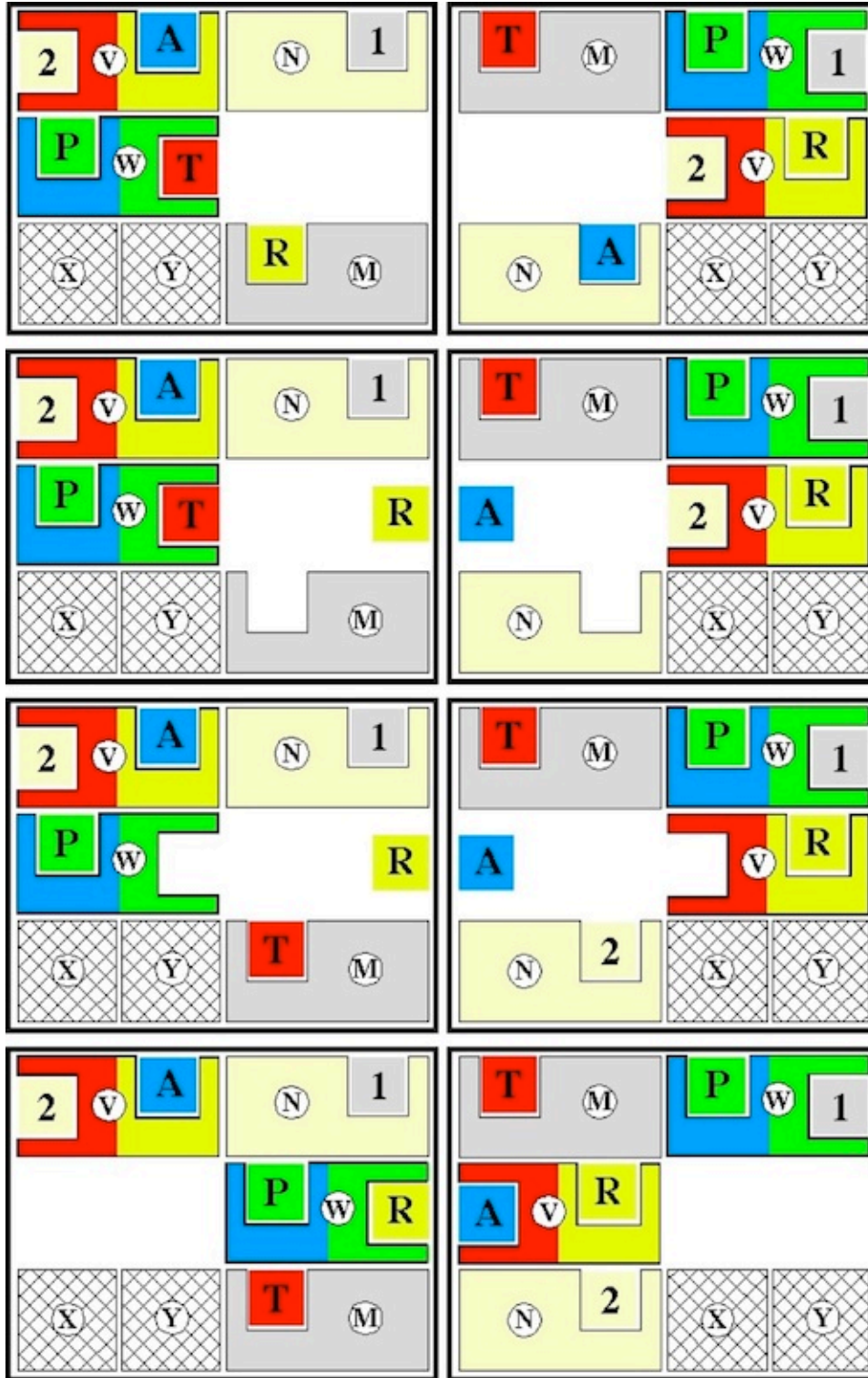
We use a more verbose notation than Hordern's book. The first letter is the piece to be moved and the second letter is the direction; all moves are a distance of 1 unit unless followed by a 2 to specify two units (moves of a little square by a non-integral distance less than two are considered 1 unit). Two consecutive moves of the same piece are listed together as a single rectilinear move. The little squares are denoted **1, 2, T, R, A, P**, the two top rectangles by **M** and **N**, the two middle rectangles by **V** and **W**, and the two bottom large squares by **X** and **Y**.

1. Yl2	2. Wd	3. Nd	4. Mr2	5. Vu	6. Xu
7. Yu	8. Wl2	9. Nd	10. Yr2	11. Xr2	12. Vd
13. Ml	14. Yu	15. Xr	16. Vr	17. Ru2	18. (Pl,Pd)
19. (Rd,Rr)	20. Ml	21. Yl	22. Xu	23. Vr	24. Md
25. Yl2	26. Xl2	27. Vu	28. Nu	29. Wr2	30. Md
31. Nl2	32. Vd	33. Xr2	34. Yr2	35. Nu	36. Vl
37. Xd	38. Yr	39. Nr	40. 2u2	41. (Rl,Rd)	42. (2d,2r)
43. Vl	44. Xl	45. Yd	46. Nr	47. Vu	48. Xl2
49. Yl2	50. Wu	51. Mr2	52. Xd	53. Yd	54. Wl2
55. Tr2	56. (Ru,Rl)	57. (Tl,Td)	58. Wr2	59. Vd	60. Nl2
61. Wu	62. Vr2	63. Xu	64. Yu	65. Ml2	66. Vd
67. Wd	68. Nr	69. Xu	70. Yl	71. Wl	72. Au2
73. (Rr,Rd)	74. (Ad,Al)	75. Nr	76. Xr	77. Yu	78. Wl
79. Nd	80. Xr2	81. Yr2	82. Wu	83. Mu	84. Vl2
85. Nd	86. Mr2	87. Wd	88. Yl2	89. Xl2	90. Mu
91. Wr	92. Yd	93. Xl	94. Ml	95. 1u2	96. (Ar,Ad)
97. (1d,1l)	98. Wr	99. Yr	100. Xd	101. Ml	102. Wu
103. Yr2	104. Xr2	105. Vu	106. Nl2	107. Xd	108. Yd
109. Vr2	110. 2l2	111. (Au,Ar)	112. (2r,2d)	113. Vl2	114. Wd
115. Mr2	116. Vu	117. Wl2	118. Xu	119. Yu	120. Nr2
121. Wd	122. Vd	123. Ml	124. Yu	125. Xr	126. Vr
127. Pu2	128. (Al,Ad)	129. (Pd,Pr)	130. Ml	131. Yl	132. Xu
133. Vr	134. Md	135. Yl2	136. Xl2	137. Vu	138. Nu
139. Wr2	140. Md	141. Nl2	142. Vd	143. Xr2	144. Yr2
145. Nu	146. Vl	147. Xd	148. Yr	149. Nr	150. Tu2
151. (Pl,Pd)	152. (Td,Tr)	153. Nl	154. Vl	155. (Xl,Xu)	156. Wu
157. Mr2	158. Vd	159. Wl2	160. 1r2	161. (Pu,Pl)	162. (1l,1d)
163. Mu	164. Vr2	165. Wd	166. Ml2	167. Xd	168. Yd
169. Nr2	170. Mu	171. Wu	172. Vl2	173. Xd	174. Yd
175. Wr2	176. Vu	177. Xl2			

(177 rectilinear moves, 196 straight-line moves)

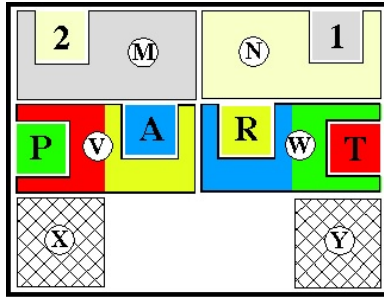
Reducing Hordern's Solution by Two Moves

A two move reduction can be achieved by changing what happens at position 54 to accomplish the effect of the four moves 55 through 58 in three moves (left below) and also at (now) position 108 to accomplish the effect of the four moves 109 through 112 in three moves (right below):

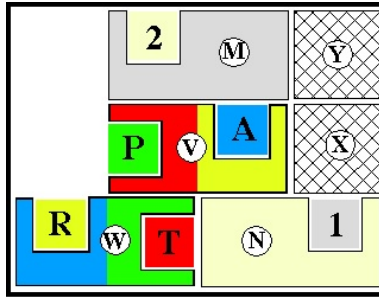


Reducing Hordern's Solution by Three Moves

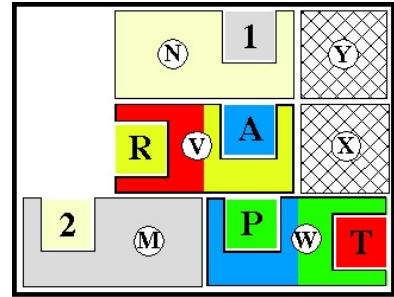
An additional move can be saved by using a partial capture move for exchange 9. As shown here, partial capture moves can also be used for exchanges 3 and 6 (but are not necessary for those exchanges, which can instead be done in the same number of moves by employing a capture move that slides over a small square). Below are the start, end, and each of the nine positions where an exchange occurs.



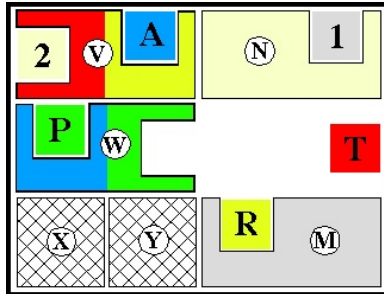
position 0



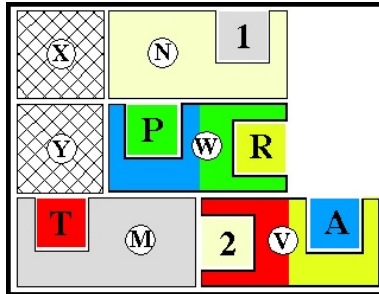
position 16



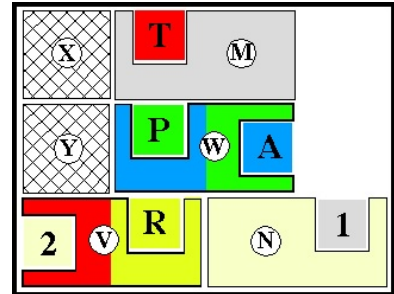
position 39



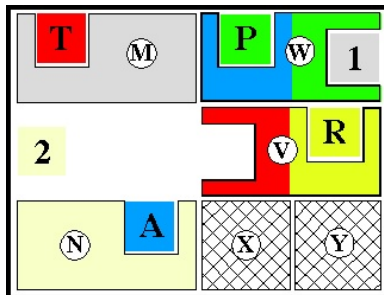
position 54



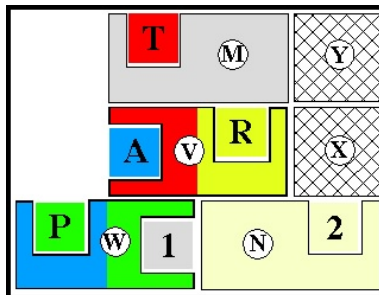
position 70



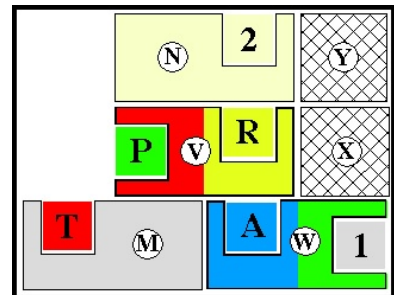
position 93



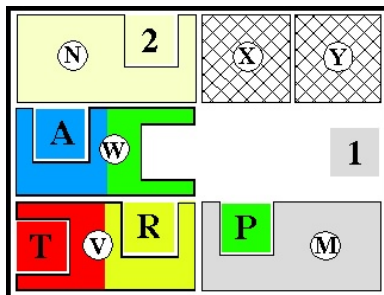
position 108



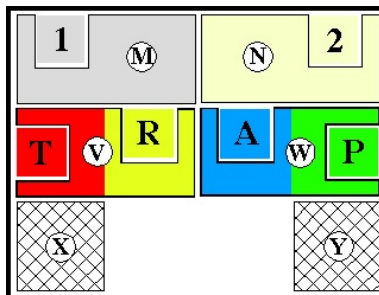
position 124



position 147



position 157



position 174

The Complete 174 Move Modified Hordern Trap Solution

For a 174 rectilinear moves solution, we again use a more verbose notation than Hordern's book. The first letter is the piece to be moved and the second the direction; all moves are distance 1 unit unless followed by 2 (moves of a little square by a non-integral distance less than 2 count 1 unit). Two consecutive moves of the same piece are listed together as a single rectilinear move. The little squares are denoted **1, 2, T, R, A, P**, the two top rectangles by **M** and **N**, the two middle rectangles by **V** and **W**, and the two bottom large squares by **X** and **Y**. In addition / means do not move that letter; e.g., **Wl2/T** means move **W** left two units but without dragging the **T** with it.

1. Yl2	2. Wd	3. Nd	4. Mr2	5. Vu	6. Xu
7. Yu	8. Wl2	9. Nd	10. Yr2	11. Xr2	12. Vd
13. Ml	14. Yu	15. Xr	16. Vr	17. Ru2	18. (Pl,Pd)
19. (Rd,Rr)	20. Ml	21. Yl	22. Xu	23. Vr	24. Md
25. Yl2	26. Xl2	27. Vu	28. Nu	29. Wr2	30. Md
31. Nl2	32. Vd	33. Xr2	34. Yr2	35. Nu	36. Vl
37. Xd	38. Yr	39. Nr	40. 2u2	41. (Rl,Rd)	42. (2d,2r)
43. Vl	44. Xl	45. Yd	46. Nr	47. Vu	48. Xl2
49. Yl2	50. Wu	51. Mr2	52. Xd	53. Yd	54. Wl2/T
55. (Ru,Rl)	56. (Tl,Td)	57. Wr2	58. Vd	59. Nl2	60. Wu
61. Vr2	62. Xu	63. Yu	64. Ml2	65. Vd	66. Wd
67. Nr	68. Xu	69. Yl	70. Wl	71. Au2	72. (Rr,Rd)
73. (Ad,Al)	74. Nr	75. Xr	76. Yu	77. Wl	78. Nd
79. Xr2	80. Yr2	81. Wu	82. Mu	83. Vl2	84. Nd
85. Mr2	86. Wd	87. Yl2	88. Xl2	89. Mu	90. Wr
91. Yd	92. Xl	93. Ml	94. 1u2	95. (Ar,Ad)	96. (1d,1l)
97. Wr	98. Yr	99. Xd	100. Ml	101. Wu	102. Yr2
103. Xr2	104. Vu	105. Nl2	106. Xd	107. Yd	108. Vr2/2
109. (Au,Ar)	110. (2r,2d)	111. Vl2	112. Wd	113. Mr2	114. Vu
115. Wl2	116. Xu	117. Yu	118. Nr2	119. Wd	120. Vd
121. Ml	122. Yu	123. Xr	124. Vr	125. Pu2	126. (Al,Ad)
127. (Pd,Pr)	128. Ml	129. Yl	130. Xu	131. Vr	132. Md
133. Yl2	134. Xl2	135. Vu	136. Nu	137. Wr2	138. Md
139. Nl2	140. Vd	141. Xr2	142. Yr2	143. Nu	144. Vl
145. Xd	146. Yr	147. Nr	148. Tu2	149. (Pl,Pd)	150. (Td,Tr)
151. Nl	152. Vl	153. (Xl,Xu)	154. Wu	155. Mr2	156. Vd
157. Wl2/1	158. (Pu,Pl)	159. (1l,1d)	160. Mu	161. Vr2	162. Wd
163. Ml2	164. Xd	165. Yd	166. Nr2	167. Mu	168. Wu
169. Vl2	170. Xd	171. Yd	172. Wr2	173. Vu	174. Xl2

(174 rectilinear moves, 193 straight-line moves)

The Trap 174 Move Solution Vs. 175 Move Solution

Define a *partial capture move* as one where the capture piece slides away from a captured piece and leaves it behind, and a *catch capture move* as one where the capture piece slides over a piece at the end of its move to capture that piece.

Computer simulation of Hordern's solution computed a solution of 175 rectilinear moves that uses only catch capture moves for exchanges and no partial capture moves. That solution can be reduced by one move to 174 rectilinear moves by using a partial capture move for the final exchange.

In the output shown below for exchange 9 of the 175 move solution, move 157 can use a partial capture move to leave piece *I* behind, and move 158 can be eliminated (position 159 now has piece *I* at the middle right, and move 60 can move piece *I* into piece *M*):

#157. Move W:

```

N N N N N N 2 2 2 N X X X X X Y Y Y Y Y
N N N N N N 2 2 2 N X X X X X Y Y Y Y Y
N N N N N N 2 2 2 N X X X X X Y Y Y Y Y
N N N N N N N N N N X X X X X Y Y Y Y Y
N N N N N N N N N N X X X X X Y Y Y Y Y
W A A A W W W W W
W A A A W W W 1 1 1
W A A A W W W 1 1 1
W W W W W W 1 1 1
W W W W W W W W W
V V V V V V R R R V M P P P M M M M M M
T T T V V V R R R V M P P P M M M M M M
T T T V V V R R R V M P P P M M M M M M
T T T V V V V V V M M M M M M M M M M
V V V V V V V V V M M M M M M M M M M

```

#159. Move P:

```

N N N N N N 2 2 2 N X X X X X Y Y Y Y Y
N N N N N N 2 2 2 N X X X X X Y Y Y Y Y
N N N N N N 2 2 2 N X X X X X Y Y Y Y Y
N N N N N N N N N N X X X X X Y Y Y Y Y
N N N N N N N N N N X X X X X Y Y Y Y Y
W A A A W W W W W
W A A A W W W P P P
W A A A W W W P P P
W W W W W W P P P
W W W W W W W W W
V V V V V V R R R V M
T T T V V V R R R V M
T T T V V V R R R V M
T T T V V V V V V M M M M M M M M M
V V V V V V V V V M M M M M M M M M M

```

#158. Move 1:

```

N N N N N N 2 2 2 N X X X X X Y Y Y Y Y
N N N N N N 2 2 2 N X X X X X Y Y Y Y Y
N N N N N N 2 2 2 N X X X X X Y Y Y Y Y
N N N N N N N N N N X X X X X Y Y Y Y Y
N N N N N N N N N N X X X X X Y Y Y Y Y
W A A A W W W W W
W A A A W W W
W A A A W W W
W W W W W W
W W W W W W W W W
V V V V V V R R R V M P P P M M M M M M
T T T V V V R R R V M P P P M M M M M M
T T T V V V R R R V M P P P M M M M M M
T T T V V V V V V M M M M M M M M M M
V V V V V V V V V M M M M M M M M M M

```

#160. Move 1:

```

N N N N N N 2 2 2 N X X X X X Y Y Y Y Y
N N N N N N 2 2 2 N X X X X X Y Y Y Y Y
N N N N N N 2 2 2 N X X X X X Y Y Y Y Y
N N N N N N N N N N X X X X X Y Y Y Y Y
N N N N N N N N N N X X X X X Y Y Y Y Y
W A A A W W W W W
W A A A W W W P P P
W A A A W W W P P P
W W W W W W P P P
W W W W W W W W W
V V V V V V R R R V M 1 1 1 M M M M M M
T T T V V V R R R V M 1 1 1 M M M M M M
T T T V V V R R R V M 1 1 1 M M M M M M
T T T V V V V V V M M M M M M M M M M
V V V V V V V V V M M M M M M M M M M

```