

British Endgame Study News

Special number 46

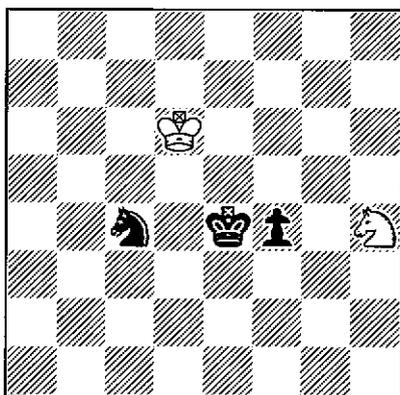
March 2006

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ISSN 1363-0318

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Gems discovered by computer



White can save the game only by playing Ke7!

Gems discovered by computer

A feature of the endgame study world during the last fifteen years has been the appearance of studies which have owed their existence to computer discovery rather than to conventional composition. Some have simply been "busts": a composer or other analyst has put a position on the computer and asked it to verify his verdict, and it has reported a demolition more attractive than what it was being asked to check. Others have been brought to light by the systematic analysis of positions with very few men, and it is with these that we shall concern ourselves here.

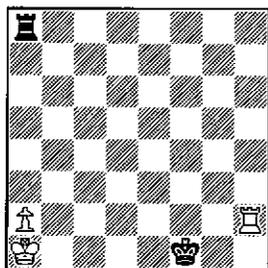
The first such analyses were performed in 1967-70 by Ströhlein and Zagler, who examined various four-man endings and found at least one deep and difficult win with $R \ v \ N$ which appeared to have escaped human discovery. But this merely dotted an i and crossed a t , and the first upset to established theory came with a 1974 analysis of $Q + Pb7 \ v \ Q$ by Komissarchik and Futer. This showed that some "surely drawn" endings with this material yielded to long and apparently patternless winning manoeuvres which only a computer could be expected to find.

The next key moment came in 1983, when Ken Thompson and Ofer Comay, working independently, showed that $K + 2B$ could normally force a win against $K + N$ in the absence of a 50-move rule. Ken Thompson subsequently analysed a selection of five-man endings, and the resulting "Thompson five-man databases", made publicly available on CD-ROM, were a standard reference source throughout the 1990s. The analysis of five-man endings was later taken up and completed by Eugene Nalimov, producing the "Nalimov tablebases" which are now routinely used by strong chess programs.

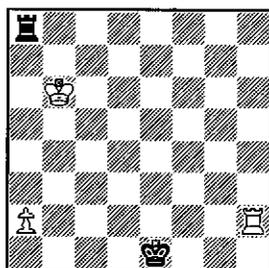
The first six-man endings were analysed by Lewis Stiller in 1991, but this was a one-off exercise using a special machine and the results could not be preserved for subsequent examination; all we had were the longest wins, some of the positions of reciprocal zugzwang, and some statistics. But by 1999 a six-man ending could be attacked using conventional equipment, and progress was resumed. The calculation of such endings was completed by Eugene Nalimov last year, and at the time of writing a position-by-position enquiry service covering most of them is available on Eiko Bleicher's web site (www.k4it.de).

Last year also saw the announcement by Marc Bourzutschky of the first definitive analysis of a seven-man ending, and he and Yakov Konoval have been striding ahead; as at mid-December, they had calculated some 50 of the 736 seven-man endings without pawns. Additionally, whereas all previous major advances had been made using the facilities of leading scientific research institutions, Marc and Yakov are using off-the-shelf personal computers such as are available to all of us.

Such an analysis produces (a) a definitive table listing each possible position in turn and giving the result assuming best play for each side, counting moves either to mate or to some other key event such as a capture, (b) a specimen longest win, and (c) a list of the reciprocal zugzwangs (Black to play loses, but White to play cannot win). Some of these reciprocal zugzwangs can be quite remarkable, as is shown by **1**, a



1 - reciprocal zugzwang (!)

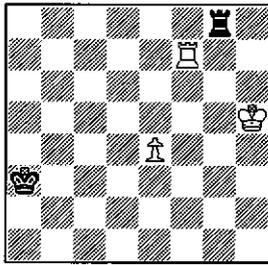


1a - 1...Ke1, after 8...Ra8

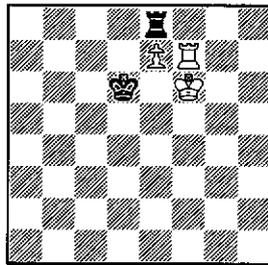
position highlighted by John Nunn in his book *Secrets of Rook Endings*. That a rook move loses is easily understood (a move off the file allows the pawn to advance, a move downwards will allow the White king to gain a tempo attacking it later on) and 1...Kg1 takes the king further from the a-file, but why is 1...Ke1 bad? Let's look at a winning line: **2 Kb2 Rb8+ 3 Kc3 Rc8+ 4 Kb4 Rb8+ 5 Kc5 Ra8 6 Kb5 Rb8+ 7 Kc6 Ra8 8 Kb7 Ra4 9 Kb6 Ra8** (see 1a) and White can play **9 Rh4** because 9...Rxa2 loses the rook. Put the Black king back on f1, and he can't.

1 is of course a position rather than a study, but where we have an interesting position we can always hope to base a study on it. Sometimes, indeed, the computer can give us a worthwhile study without the need for any further work on our part. For a perhaps surprising example, had the now famous as-Suli position (see the 1992 edition of the *Oxford Companion to Chess*, pages 401-2, or pages 85-7 of *Endgame Magic*) not been originally discovered by as-Suli, and its long-lost solution not been rediscovered by Yuri Averbakh in 1986, it would have come to light as soon as anybody performed a definitive computer analysis of endings with this material, because all the longest wins pass through this position after seven moves. Other positions which may yield studies with no more effort than playing through what the computer has given are (a) positions where the win takes at least three moves longer if White is to play (any position demanding a win by triangulation or some other "get back here with Black to play" manoeuvre will satisfy this condition), and (b) positions where the only winning or drawing move is of a specified kind (for example, a pawn-one or a non-capturing retreat into a corner). Complete lists of candidate positions of these and similar kinds can now be produced automatically, and all the "composer" has to do is to thumb through them and pick out any that appear particularly interesting.

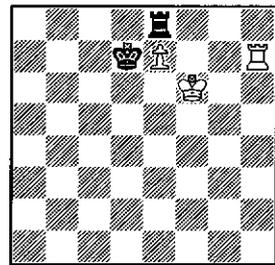
But the classic field for composition of this kind has been in the exploitation of computer-discovered positions of reciprocal zugzwang, and lists of 5-man reciprocal zugzwangs derived from the Thompson databases started to appear in *EG* from 1988 onwards. Many studies based on them have now been published, and three are presented overleaf. It is of course possible that in some cases the composer discovered the crucial reciprocal zugzwang independently, but where the Thompson-derived list was already in print I think we have to say "Sorry, the analysis by computer anticipated you".



2 - win



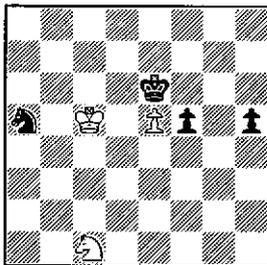
2a - after 4...Kd6 5 Kf6



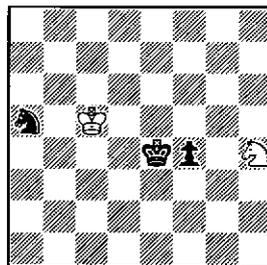
2b - further after 6 Rh7

2, by G. Amiryran, obtained 2nd HM in a 1998 tourney to celebrate five years of the magazine *Uralski Problemist*. 1 e5 is obvious, and if we count moves to mate we find that Black can hold out longest by playing 1...Re8. However, after 2 Rf5 this allows the White king to come into play (2...Re6 3 Kg5/Kg4, 2...Kb4 3 Kg6), and a more promising defence is to leave the rook where it is and play 1...Kb4. The sequel 2 e6 Kc5 3 e7 is obvious, and now the threat of Rf8 does force Black to abandon the g-file and play 3...Re8. White duly advances, 4 Kg6/Kg5, and the simplest line is 4...Kd6. White meets this by 5 Kf6, giving 2a, and there are two lines: 5...Rh8 6 Rh7! Re8 (say) 7 Rh1 with Rd1+ etc to follow, or 5...Kd7 6 Rh7 (see 2b) and again Black's next move will allow White to play Rh1 etc.

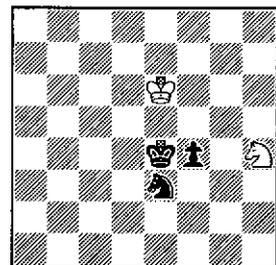
But Black can temporize with 4...Kc6, and 5 Kf6 Kd6 gives 2a with White to play. Reciprocal zugzwang? No, 6 Rg7! 6...Rh8 allows 7 Rh7 as before, hence 6...Kd7, and 7 Rh7 again gives 2b. However, the careless 6 Rh7 Kd7 gives 2b with White to play, and 2b is reciprocal zugzwang. White's rook must quit the h-file, say 7 Rg7, so Black claims it, 7...Rh8, and after 8 Rg1 the check on h6 gives Black a draw.



3 - draw



3a - after 4...f4



3b - 6 Ke6, after 6...Ne3

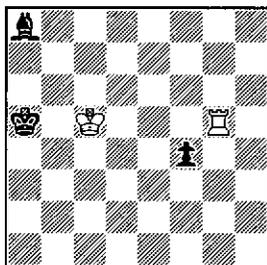
Karel Husák's 3 took a special prize in *Československý šach* in 1999. 1 Kb5 Kxe5 is hopeless, hence 1 Nd3, but 1...h4 overloads the knight (2 Kd4 Nc6+ etc) and leaves White nothing better than 2 Nf4+ Kxe5 3 Ng6+ Ke4 4 Nxh4. Now 4...f4 gives 3a, and how can White's king get into play? 5 Kd6, obviously, and after 5...Nc4+ why not the apparently natural move 6 Ke6?

The answer is that Black has a win starting 6...Ne3 (see 3b). Knight moves lose at once (if 7 Ng6 then 7...f3 etc), and White's best chance is 7 Kf6 keeping in touch with

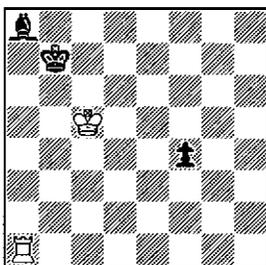
f5. Black now has the elegant move 7...Ng2! with a lovely domination of the White knight after 8 Nxf3 f3, and if instead 8 Nf5 Black can play 8...Kd3 threatening 9...f3 with ...f2 to follow (if the pawn can get safely to f2, Black has a book win). Hence 9 Nh6 ready to meet 9...f3 by 10 Ng4, but Black has 9...Ne3 covering g4, and if 10 Nf7 (a last try, hoping for 10...f3 11 Ne5+) Black can interpolate 10...Ng4+ and cover e5. One way or another, therefore, the pawn will find its way to f2, and while the subsequent win may not be easy it is always there.

So White must think of something else, and the improvement is needed at move 6: **6 Ke7!** This seems to take the White king away from the scene of action, but after **6...Ne3 7 Ke6** we have **3b** with Black to play, and this time there is no win. Suppose 7...Ng2 as before; White continues **8 Nf5** to meet an immediate 8...f3 by 9 Ng3+ and 10 Nh1, after **8...Kd3** he again plays **9 Nh6** ready to meet 9...f3 by 10 Ng4, after **9...Ne3** he again plays **10 Nf7** ready for 10...f3 11 Ne5+, and at last we see the difference: with White's king still on e6, Black's **10...Ng4** isn't check, and White has time for **11 Ng5**. This stops the pawn short of f2, and White has his draw.

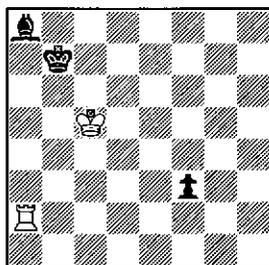
"Draw" studies with "book draw" material often peter out without coming to a proper climax, but I don't think this is true here. If we accept that Black will have a win as soon as his pawn reaches the seventh rank, the need for White to prevent its doing so gives an immediate urgency to the play, and the move 6 Ke7 deserves its place in any company. Why won't 6 Kd7 do instead? Because Black would have 6...Ne5+ and 7...Ng6 winning at once (8 Ng2 f3 etc). With his king on e7, White can foil this by playing 7 Kf6.



4 - win



4a - after 2...Kb7

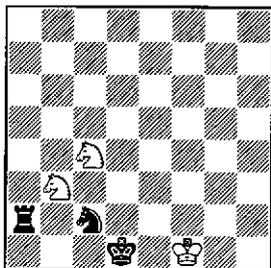


4b - 3 Ra2, after 3...f3

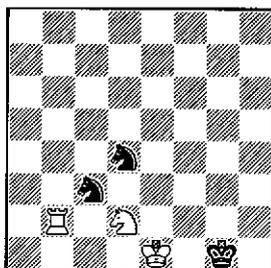
Play in G. Unmov's 4 (2HM *Shakhmatnaya kompozitsiya* 2001) starts **1 Rg1 Ka6 2 Ra1+ Kb7**, and we have **4a**. If there were no f-pawn, White could now play a waiting move and then meet ...Kb8 with Kb6 and a standard win, but the pawn complicates matters. Try 3 Ra2: no, 3...f3 gives **4b**, and another rook move will let the pawn advance further. But might this not be a win with *Black* to move, say after **3 Ra- f3 4 Ra2**? Indeed it is (after **4...Kb8 5 Kb6** the hardest line to find is **5...Be4 6 Ra4 Bb1 7 Rb4 Ba2 8 Kc6+ Kc8 9 Ra4**), so where should the rook go at move 3?

Try 3 Ra3 followed by 3...Kb8 4 Kb6: no, 4...Be4 and 4...Bg2 both draw. Try 3 Ra4 attacking the pawn: no, 3...Kb8, with 4 Rxf4 Bg2/Bh1 5 Kb6 Kc8 or 4 Kb6 Bg2/Bh1. Try **3 Ra5**: ah, now 3...Kb8 4 Kb6 leaves Black without a good move (4...Be4/Bg2/Bh1 5 Re5/Rg5/Rh5), and after **3...f3** we have **4 Ra2** as planned.

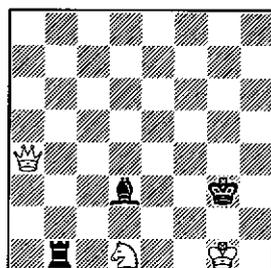
The most striking reciprocal zugzwangs are of course the “full point” reciprocal zugzwangs where whoever is to move loses, and the possible existence of a six-man pawnless position with this property was for long a subject of conjecture. However, it gradually became clear that there almost certainly wasn't one, and Guy Haworth has clinched the matter using Eiko Bleicher's “Nalimov” tables, a powerful enquiry program written by Marc Bourzutschky, and a co-ordinating program contributed by Eiko himself. This distributed exercise in international co-operation has confirmed that there is no six-man pawnless position where whoever is to move loses, and it has gone further: it has disclosed six and precisely six “nearly full point” reciprocal zugzwangs where Black to play loses and White to play has only a single non-losing move. Each of the six has some points of interest.



5 - 1 Nc5 only



6 - 1 Ra2 only

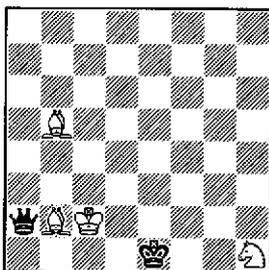


7 - Kh1 only

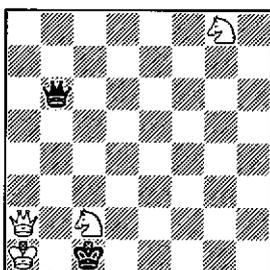
5 is the original Stiller-Elkies candidate position from 1991 (I have reversed the colours). Black to move must allow immediate mate; White to move can hold the draw by 1 Nc5, but otherwise loses (the fifty-move rule being assumed suspended).

6 is the Stiller-Elkies position shifted one file to the right and with the original colours reinstated. Now the equivalent move 1...Nd5 loses, but White to move can play 1 Ra2 (!) and avoid being mated.

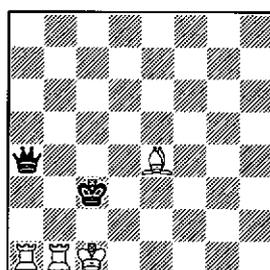
The drawing move in 7 is 1 Kh1, and if 1...Be4+ then of course not 2 Qxe4 but 2 Kg1. Black can now draw by 2...Bf3 or 2...Bd3, but he cannot win.



8 - Ng3 only



9 - Qa3+ only



10 - Rxa4 only

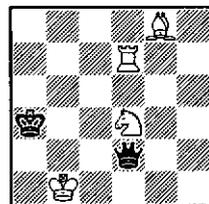
The material in 8 would normally be drawn, but Black to move must release the pin and allow a devastating check on c3, while a king or bishop move by White will allow

Black's queen to get into play and eventually win a piece (Q v 2B and Q v B + N are wins unless the defender can reach a known fortress position). After 1 Ng3, however, White will be able to consolidate. Black can try 1...Qd5, but 2 Bd3 followed by Ne2 is good enough; alternatively, White can be clever and play 2 Ne2 straight away, meeting 2...Qxb5 by 3 Nd4 establishing the Karstedt fortress.

White's problem in 9 is that if he loses control of any of the squares b2/d4/f6 he will be mated. However, Black has no square from which his queen can continue to threaten them all, and Q + 2N v Q is normally a win. But why cannot the g8 knight be on h7 instead, or even h5 or g4? As regards h7, because White's answer to 1...Qc7 is 2 Qb2+ followed by Kb1 disentangling himself, and if the distant knight is on h7 it will be under attack and White will not have time for this; as regards h5, 1...Qh5 similarly; and as regards g4, because White to move will have 1 Qa3+ Kxc2 2 Ne3+ winning the queen.

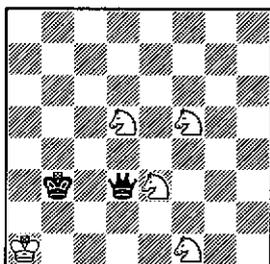
Finally, the amusing 10. 2R + B v Q is normally a winning advantage, and if Black to move tries 1...Qxe4 he loses his queen. White to move can apparently afford to drop a rook and still have a draw, but it isn't quite as easy as this; if say 1 Rb7 then 1...Qxa1+ 2 Bb1 (if 2 Rb1 then 2...Qa2 wins quickly) Qa3+ 3 Kd1 Qd6+ and the second rook soon goes, and if 1 Rb6 to cover d6 then 1...Qxa1+ 2 Bb1 Qa4 3 Rf6 Qa8 and again Black wins. White's only non-losing move is therefore the simple and obvious 1 Rxa4, and this doesn't win but gives stalemate.

Given that 6 is lost for Black to move, it is natural to ask whether the Stiller-Elkies position 5 might not be a full point reciprocal zugzwang on a 7x7 or 6x6 board. Marc Bourzutschky has confirmed that it is, and as regards the 6x6 board he tells me that it is one of only two pawnless full point positions, the other being the curious position with R + B + N v Q shown alongside. White to play here is soon seen to lose (if for example 1 Rd6 then 1...Qd1+ 2 Nc1 QxR). Black to play has several apparently safe moves including ...Qa2+ and ...Qd1+, but his king is poorly placed, the smaller board cramps his queen, and in practice White can play to mate or win the queen within 25 moves. As regards the 7x7 board, Marc has not done an exhaustive scan, but he knows of none apart from the Stiller-Elkies position (the R + B + N v Q position certainly isn't) and "would not be surprised" if this were to be unique. At first sight, 7 appears to be an alternative candidate, the move Kh1 no longer being available, but the removal of the h-file allows White to draw by 1 Qa1! since 1...Rxa1 is now stalemate.

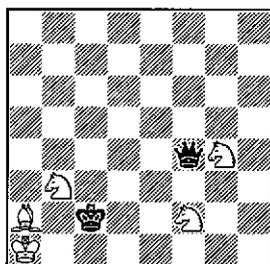


Guy makes one further point of interest. Go back to the Stiller-Elkies position 5. Not only is 1 Nc5 the only move to draw, but in the continuation line 1...Nd4 2 Ne3+ Kd2 3 Kf2 Kc3+ 4 Kg3 Ra3 5 Kf4 each of White's five moves has been an "only" move: one slip, and he would have lost. In a very real sense, therefore, this is the nearest that exists to a full point six-man pawnless reciprocal zugzwang on the 8x8 board.

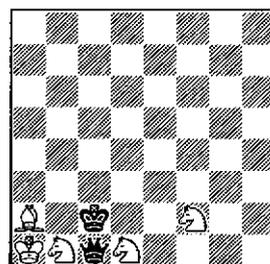
My understanding is that most of this is new. My thanks to Marc and Guy for allowing me to publish it here.



11 - reciprocal zugzwang
(full point)

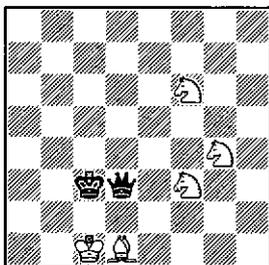


12 - reciprocal zugzwang
(full point)

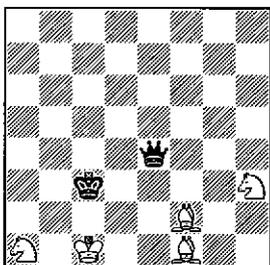


13 - reciprocal zugzwang
(full point)

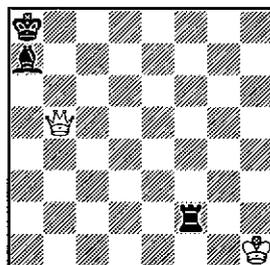
With seven men, there are pawnless full-point reciprocal zugzwangs even on an 8x8 board. One such, obtained by adding a blocked bishop on b1 to the Stiller-Elkies position 5, has been known for some time, and a further six, with $4N \vee Q$, were discovered by Marc last year and published in *EG* 156. The simplest of these is 11, where White to play must allow mate in four but Black to play must release the bind, after which White will consolidate and eventually win. Marc and Yakov have since reported four more, three with $B + 3N \vee Q$ and one with $2B + 2N \vee Q$, and no doubt others await discovery. The four with bishops and knights, shown as 12-15, are not quite as clear-cut as 11, but in each case White to play must either allow a quick mate or drop two pieces and leave Black with a book win, while Black to play must again release the bind and allow White to consolidate with an eventual win.



14 - reciprocal zugzwang
(full point)



15 - reciprocal zugzwang
(full point)



16 - reciprocal zugzwang

For my last example, I am going to return to the now classical territory of the five-man endings. 16, reported in *EG* 112 in 1994, is the only five-man pawnless reciprocal zugzwang I have spotted where the kings are at opposite ends of a long diagonal. Black to play must drop a piece, though he can set a trap by $1...Bb6$: *not* $2 Qxb6$, when $2...Rh2+ 3 Kg1 Rh1+$ leads to a draw by stalemate or perpetual check, but $2 Qa6+ Ba7 3 Qc8+ Bb8 4 Qc6+ Ka7 5 Qc5+$. White to play can try $1 Qd5+ Kb8 2 Qc6+$ making the rook move, but $2...Rb2$, $2...Rd2$, and $2...Rf1+$ followed by $3...Rd1$ all hold the draw. Sadly, it does not appear possible to use this position as the climax to a lose-a-tempo study other than by resorting to crude captures in the lead-in play.