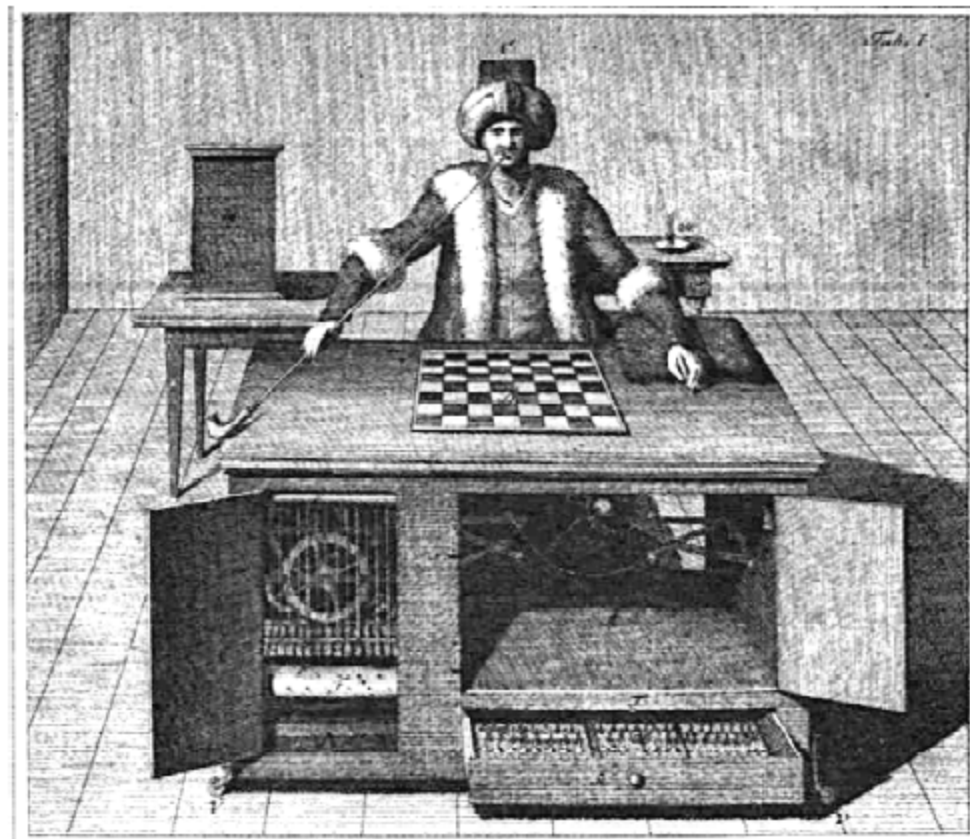


THOUGHT PROCESSES IN CHESS:

WHAT CAN WE LEARN FROM COMPUTER PROGRAMS?

Bill Reid



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THOUGHT PROCESSES IN CHESS: WHAT CAN WE LEARN FROM COMPUTER PROGRAMS? by Bill Reid

Chess is the game which, *par excellence*, has always had a big appeal to theoreticians as well as to practitioners. Already in 1512, Pedro Damiano had published a book which took a theoretical view of the game, and, in modern times, the trickle of such works has become a flood.

Usually, they approach the question of theory by contrasting **tactics**, which are thought of as ‘non-theoretical’, with **strategy**, which they consider to be the theoretical part of chess. Euwe, for example, in his landmark book ‘Judgement and Planning in Chess’¹, contrasts the making of ‘quite pretty combinations, two or three moves deep’ with ‘positional understanding’². Implicit in such analyses, though seldom specifically mentioned, is the notion of **horizon**. As we move further ahead in calculating moves, their number becomes so great that, even given infinite time, the human brain would run out of processing capacity.

So, to overcome this limitation, players should work on their ability to analyse chess positions ‘theoretically’ as well as tactically. However, the idea of ‘horizon’ was left somewhat vague, because it was not something of which practical players were specifically aware. They knew that their calculating ability was limited, but also that it went further in some lines, or some situations, than in others, that it varied enormously among players, and that it often faded gradually into positional thinking rather than hitting a sudden barrier.

With the arrival of chess computers in the 1970s, however, the question of ‘horizon’

suddenly became paramount. Few people considered that computer programs would ever be able to deal with theoretical concepts, so, if they were to challenge human players, use had to be made of their potentially superior calculating capacity. In other words, their ‘horizons’ had to be pushed beyond those of the competent practitioners of the game.

Would this make them stronger players than humans? Opinion was divided. Bronstein, who famously said ‘there are no plans in chess, only moves’, might have agreed. But a contrary view could be based on research by de Groot in the 1960s which showed that, although players at the master level tended to analyse more deeply, they were less likely than grandmasters to find the best move in a given situation³. For quite a while the strong human players were safe because, although chess programs possessed superior processing capacity, they used it up analysing every possible sequence of moves, while humans could be selective in deciding which lines were worth looking at and which could safely be ignored.

But when the 1990s arrived, fresh gains in capacity meant that, even though machines might waste time looking at unpromising moves, they could still out analyse a human opponent.

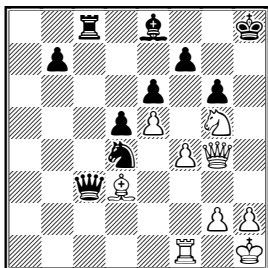
■ ¹ An English translation by Du Mont was published by G. Bell and Sons, Ltd. (London) in 1953.

■ ² p. ix in the Du Mont translation.

■ ³ De Groot, A.D., *Thought and Choice in Chess*, The Hague, Mouton, 1965. Of course, it could be objected that de Groot could only discuss *conscious* analysis, and it might be that analysis was going on in grandmasters’ minds of which they were unaware.

Here is an example of the ability of Rebel 8.0, which appeared in 1995, and is currently rated at 2439 Elo⁴, to find the best tactical line in a fairly complex position.

Position 1 White to move



In its slowest tournament mode, Rebel, on a 150Mhz machine, used lots of time thinking about 1.Qh3+ but could still come up with 1.Bxg6!, the point of which is that after 1...fxg? 2.Qh4+ Kg8 3.Qh7+ Kf8, White wins with the brilliant (to human eyes) 4.f5!!

All captures of the f-pawn lead to a rapid loss, as does also the amazing riposte 4...Qc1. Thus, the best Black can do is opt to lose less rapidly with 1...Qc7⁵.

This position, as well as illustrating the advance in calculating power that programmers had achieved by the mid-90s, is a good example of a way in which machines can sometimes outwit humans.

We might describe the move 4.f5!! as ‘counterintuitive’ because it doesn’t come naturally to us to push a pawn onto a square where it can be captured in three different ways. But to a program a move is a move is a move! They all look alike.

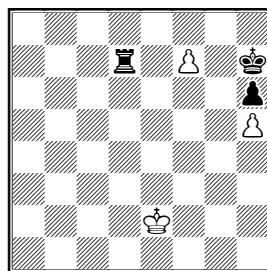
Of course, the human player (not the program!) who, as Black, *has* seen 4.f5!! might still play 1...fxg against another human, gambling on the chance that White *hasn’t* seen it! But this won’t work against the machines.

So, as we enter a new decade and even more powerful programs become available, have we now reached a point where the notion of ‘chess theory’ has to be discarded because the programs have shown that Bronstein was right and ‘tactics’ are the answer to everything? Well, perhaps some exceptions have to be made?

For example, we can (and if we are programmers we must) keep a place for something called ‘endgame theory’. Our tactical sequence may take us to a point where we apparently have a winning advantage, but it could be a situation - such as having a- or h-pawn plus bishop of the wrong colour to control the queening square - where our material plus is actually ineffective and we won’t get the full point.

Here is an example of this kind that Rebel 8.0 can’t cope with.

Position 2 White to move



In this position the consequences of White’s initial move are ‘over the horizon’.

If the obvious 1.f8=Q? is played then the game is drawn as, after 2...Rd2+, Black can go on endlessly checking because the capture of the rook will give stalemate (or, if the White King heads down the board, and White swaps Queen for Rook and captures

■ ⁴ In *Selective Search* 103, Dec. 2002-Jan. 2003.

■ ⁵ For further analysis, see *Selective Search* 76, June-July 1998, p.25.

the h-pawn, the game is still drawn because rook pawn plus King against King is unwinnable).

However modern programs, such as Fritz 8, have no problem with such positions because they incorporate endgame tablebases or under-promotion routines designed to overcome that particular 'horizon' problem. Therefore they will find $1.f8=N+!$ quite quickly ⁶.

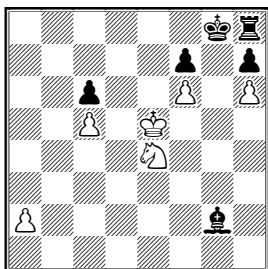
But should such programs be regarded as possessing theoretical knowledge?

Is it not rather a case of adding further sets of facts, or rules, to the existing facts or rules about moving pieces that they need in order to play the game in the first place? Such a line of thought of course reflects back on human players. Do they really have access to 'theoretical' insights, or are they too simply stacking up more and more facts and rules that help them score wins?

Perhaps computer programs have brought us to the point of questioning the role of 'theory' in the playing of chess. But does that mean that the game becomes purely a matter of tactics?

Let's look another kind of horizon problem.

Position 3 White to move



White should resign. There is no way of preventing Black from going $1...Kf8$ after which the rook escapes via g8 and the win is

straightforward. But what if a computer program is playing the Black pieces? Then it's worth trying a little swindle with $1.Kd6?!?$

Surely programs that are cute enough to see moves like $f5!!$ in **Position 1**, three turns ahead, can't be swindled? Well, actually, even Fritz 8, and given ample time to think, falls right into the trap and plays $1...Bxe4??$ Naturally, White goes $2.Ke7$ and now the Black rook is permanently out of play as White shuttles the King between e7 and e8 (any attempt to foil this drawing manoeuvre by playing the bishop to d7 can be stopped by the advance of the a-pawn) ⁷.

How should we describe this kind of 'horizon-transcending' position? I propose that we call it an example of a **static**. This term describes a situation where some feature or features of a position are not subject to alteration.

In **Position 3**, after $2.Ke7$, the rook that is buried on h8 will stay buried for ever. A *static* is the opposite of a *tactic*.

To employ a **tactic** is to engage in a process of changing the relationship of the pieces on the board and depends on fluid factors in the situation. After $1.Bxg6$ in **Position 1**, the piece can be captured. Then, however, $2.Qh4+$ and $3.Qh7+$ force the King to f8, when $4.f5!!$ threatens to open the f-file and all attempts to stop that happening meet with tactical refutations.

In creating or exploiting a **static**, however, we use features of a position that are not fluid and are not subject to modification.

⁶ See *Selective Search* 101, Aug.-Sept. 2002, p.4.

⁷ See *Selective Search* 79, Dec. 1998-Jan. 1999, p.16.

We could also bring situations such as that of **Position 2** under the ‘static’ category. Pieces can be moved, but what they are capable of achieving by moving is limited by some permanent feature of the setup such as the presence of a bishop of the ‘wrong’ colour.

Perhaps, then, we can better describe what is going on in the minds of human players, as well as in the calculations of computers, if we conceive of chess as a game of **tactics** and **statics**, rather than tactics and strategy?

In one way, this looks like bad news for humans. Since the time of Damiano they have been able to think of themselves as having access to ‘theoretical’ insights which are far more subtle than mere knowledge of rules.

And now are they to be denied this possibility? Well, the programs are already showing that the notion of ‘theory’ is a bit shaky.

Just before writing this, I played through the games of the recent Deep Fritz v. Kramnik match⁸. The representative of the humans started well, but at the end was just about hanging on for a 4-4 draw, in spite of his apparently deep ‘theoretical’ appreciation of chess positions. But, in another way, the news is good. If humans have the ability to spot static features of a position that will influence the game way beyond the tactical horizons of computer programs, then perhaps their prospects of taking on the machines with a chance of winning are not so bad after all?

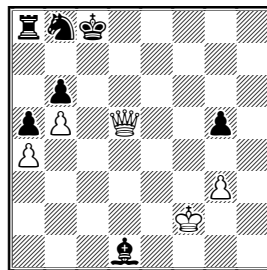
Surely, however, the opportunities for exploiting statics are rather limited? First of all, as we have seen, some of the static features of chess, such as the inability of opposite coloured bishops to translate a material advantage into a win in the endgame, can be dealt with by ‘booking up’ the programs. A little checking up in their

libraries and they will see the problem ahead of time. Also, surely, situations like that of **Position 3** are relatively rare and not easy to bring about deliberately?

Considerations such as these constitute a difficulty if we stick rigidly with the notion of tactics and statics as distinct and opposite categories. But we can bring some flexibility into our conception. Rather than regarding tactics and statics in that way, we can treat them with some flexibility and, for example, entertain the idea of a **semi-static**.

Position 4 illustrates my point.

Position 4 Black to move



Black, our human player, is in bad shape but, confronted by a program, could try to tempt it into a semi-static with 1...g4!?, the point being that 2.Qxa8 - the reply that seems to yield the biggest advantage - leaves the Queen awkwardly stuck on a corner square and unable to influence the outcome of the game after 2...Bf3.

There could follow 3.Qa7 Nd7 4.Ke3 Bb7 5.Kf4 Kc7 6.Kxg4 Nc5 7.Kf5 Nxa4 8.g4 Nc3 9.g5 Nxb5 when the Queen has to be given up for the bishop and the game is drawn (10.Qxb7+ Kxb7 11.g6 Nd6+ 12.Ke6 Ne8, etc.)⁹.

⁸ Reported in *Selective Search* 103, Dec. 2002-Jan. 2003, pp.9-20.

⁹ For further commentary and analysis, see *Selective Search* 94, June-July 2001, p.7.

Thus, the best move for White is 2.Qxd1, when the Queen captures a piece of lesser value but maintains active participation in the game.

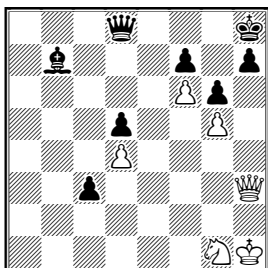
This position divided the programs. Some, such as CS-Tal, Gambit Tiger 2 and Fritz 8, could see far enough to know that Qxa8 was best avoided, and some could not.

Position 4 draws our attention to another term which needs to be added to tactics and statics in our analysis of how to find 'best' moves. That is **pragmatics**.

Human players know that, especially in middle games, a lot of the outcomes of the moves they choose are going to be uncertain - 'if I play this, I might find myself with a valuable passed pawn in about ten moves time', or 'if I can provoke h6, then, somewhere down the road, I might get a King's side attack going'. Programs, of course, have their algorithms which tell them that 'after six moves this choice gives +0.7, whereas that one gives +0.9'. But that is not quite the same as the ability to say, in **Position 4**, 'Well, I don't see for sure that the Queen will get trapped if I go Qxa8, but it looks like a strong possibility and there's no need for me to take that risk'.

With all that in mind, who should do better in **Position 5**, programs or humans?

Position 5 Black to move



The temptation is to play 1...c2, saving the

pawn from capture and threatening to queen it in one more move. But human players would quickly back off from that and prefer either 1...h5 or 1...Ba6.

The problem with 1...c2 is that White can reply 2.Qh6, setting up an awkward static. The threat of mate forces 2...Qg8 when not only is the Black Queen tied up, but, just as importantly for the outcome of the game, also the Black King. Now White can go 3.Ne2 stopping the pawn from queening. The White King then ambles across to cover the queening square, releasing the knight, which will eventually win the game by moving to e7, aided by the fact that White can always lose a move because of the mobility of the King¹⁰.

It takes quite a while, but a human player of the White pieces would see the inevitability of the outcome without analysing every line in detail. All of this is over Fritz 8's horizon.

Position 5 illustrates another feature of statics. They can be thought of as providing opportunities for human players to engage in 'thinking backwards'.

When limitations on the possibilities for movement due to static features of a position are taken into account, opportunities for tactical thinking can be enhanced. It becomes possible to visualise a favourable position which might occur quite a way ahead because the modifications to the existing position which would be required are limited.

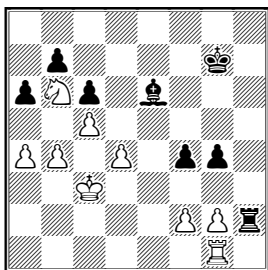
In **Position 5**, once Qh6 is played, very little can happen to the arrangement of the pieces. The only pawn capable of movement can easily be blocked, while the Black bishop can only move on the White squares.

■ ¹⁰ For further commentary and analysis, see *Selective Search* 104, Feb.-March 2003, p.7.

Therefore, it is not difficult to visualise a position where Black is lost because the knight will arrive on e7.

Here is another example of backward thinking.

Position 6 White to move



This is taken from a game played between Alekhine and Bogoljubov in 1922. White has an extra pawn but there are rooks on the board and Black's is more active than White's, so the win is not straightforward.

Alekhine, however, looks ahead to a future position which would leave Black with no defensive resource, and then comes back to the present one to try to see how it could be brought about. White has a knight on b6 controlling the queening square of the c-pawn. So, if the way could be cleared for that pawn to advance, it would cost Black a piece and the game.

With that in mind, he played 1.d5!, giving up his extra pawn. Bogoljubov replied with 1...cxd 2.Kd4 g3 3.f3 Kf6, but was lost after 4.b5! because of the threat posed by the c-pawn¹¹.

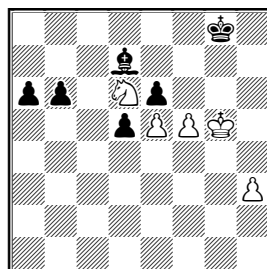
The latest programs, such as Fritz 8, can find this, but only with plenty of time to think.

Finally, what of **pragmatics**? Does that have to be thought about as a rather vague matter of weighing up pluses and minuses in terms of what might happen on the board?

Here too perhaps ideas can be developed which can take the human player (and the computer program?) beyond the application of 'common sense'. Rowson, for example, suggests that the pragmatics of a position can be explored by 'talking to the pieces'¹², since there is more to their nature than simply the rules for how they move.

Position 7 provides us with an example.

Position 7 White to move



The obvious moves that come into account are 1.Kf6 and 1.f6. But which one should be preferred?

1.Kf6 looks like the way to go, since it wins a piece for two pawns and frees up the knight, while 1.f6 seems to leave the way open for Black's passed pawns to advance in a position where the knight will find it hard to head them off.

But maybe we should 'speak to' the knight about this?

If we engage him in conversation, we will find that he loves to sit on squares like d6 where he can cause all sorts of embarrassment to the Black King and would not be at all happy trying to chase after passed pawns.

■ ¹¹ For a full analysis of this position, see *Selective Search* 91, Dec. 2000-Jan. 2001, p.22.

■ ¹² Rowson, Jonathan, *The Seven Deadly Sins of Chess*. London. Gambit Publications. 2000. p.40.

So, assuming we are keen on getting the win, we might listen to him and go 1.f6! The sequel could be 1...Bb5 2.h4 Be2 3.h5 Kf8 4.Nb7 (now he's really happy!) Ke8 5.Kg6 Kf8 6.Nd8 Bd3+ 7.Kg5 Bf5 8.h6¹³.

White has won and the Black pawns have gone nowhere. The latest programs, such as Fritz 8, can find the right answer here.

This study of human and machine 'thinking' about chess suggests that the model that both human players and programmers need to work with is one that focusses on the concepts of **tactics**, **statics**, and **pragmatics**.

At the beginning of a game, tactics are paramount and here the better players, just like the machines, have always been 'booked up'.

But, as the game progresses, not only do opportunities for even sharper tactical manoeuvres come along - much to the benefit of the machines - but also occasions for creating and exploiting statics, which may be something that humans can handle better than the machines.

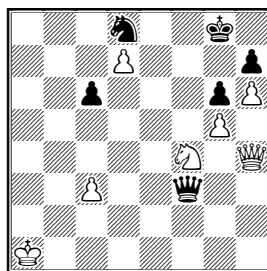
This is especially the case because of their ability to think pragmatically, weighing up those aspects of positions that involve immediate tactics against static or semi-static features which can push an ultimate resolution over the tactical horizon.

The contest between program and humans over tactical ability has clearly been won by the programs. Now, perhaps, human players can fight back by challenging programmers to produce programs that can cope with statics and think pragmatically?

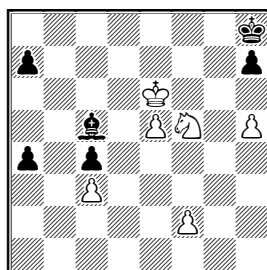
Further Positions

Here are some more positions to illustrate the concepts which have been discussed. They also provide us with opportunities to check our own and our programs' abilities to make use of them.

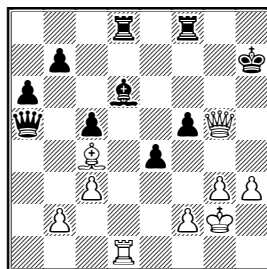
Position 8 White to move



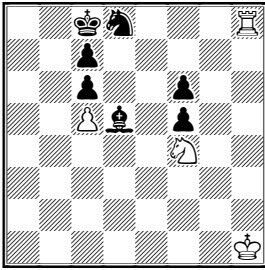
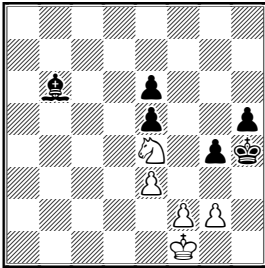
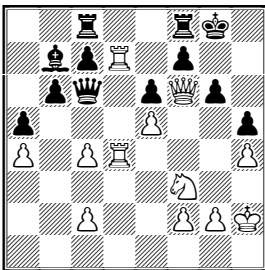
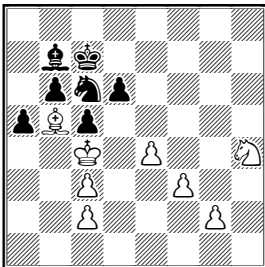
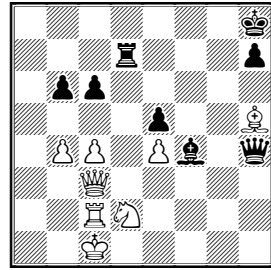
Position 9 White to move



Position 10 White to move



■¹³ For further analysis and commentary, see *Selective Search* 103, Dec. 2002-Jan. 2003, p.8.

Position 11 White to move**Position 12** Black to move**Position 13** White to move**Position 14** Black to move**Position 15** White to move**Commentaries on Further Positions****Position 8**

The winning move here is 1.Qe1! 1.Kb2 is only good enough for a draw (1...Qd1 2.Qf2 Qxd7).

The point of 1.Qe1! is that it forces 1...Qxf4 (to stop the mate threat 2.Qe8+) and then after 2.Qe8+ Qf8 the Black King and Queen are completely tied down, and the Black Knight has to keep guard on d8 to prevent the pawn queening. But the White King can roam the board freely and create winning threats, e.g. 3.c4 Nf7 4.Kb2 c5 5.Ka3 Nd8 6.Kb3 Nb7 7.Ka4 Nd8 8.Kb5 Nf7 9.Kc6 Nd8+ 10.Kb6 Nf7 11.Kc7.

Programs think 1.Kb2 is best. 1.Qe1! is also quite hard for human to find because of the immediate loss of material, but stronger players will choose it.

The position here counts as an example of a **static**. Once the White Queen arrives on e8 Black's ability to manoeuvre becomes effectively zero.

There is also some role for **pragmatics** ('weighing up the odds') because a human player can see that 1.Kb2 is only good for a draw and that there is still a draw after 1.Qe1

Qxf4 2.Qe8+. So going for that option doesn't risk anything and who knows what might turn up with the Black forces confined to barracks?

Position 9

This looks like a resignable position for White, and programs treat it as if it were and settle on 1.Kd5?, after maybe flirting with Kf7 early on. This move does nothing to hold up the queening of the Black a-pawn. Of course, nothing *can* be done about that, but is there any way White can cash in some counter chances?

To the human eye, the best try is 1.Kf7! This takes advantage of the Black King's cramped position, and who knows what may turn up? Play continues 1...a3 2.Nh4 h6 (forced, since 2...a2? 3.Ng6+ hxg 4.hxg will win for White) 3.Ng6+ Kh7 4.e6 a2 5.e7 Bxe7 6.Nxe7 a1=Q 7.Ng6.

Black has at last queened the a-pawn, but now White threatens a perpetual check with 8.Nf8+, etc. So, 7...Qa3. But after 8.f4 a5 9.f5 it's still a draw because Black must move the Queen out of the way of the a-pawn, whereupon White goes 10.Nf8+ Qxf8+ 11.Kxf8 and the f-pawn reaches the queening square in time to save the game.

This is hard for programs, though some can get it. Humans who want to play on will definitely choose 1.Kf7! But some might just resign!

Ideas here are the **semi-static** and **pragmatics**, but also maybe some **talking to pieces**.

Human players who have read their Rowson¹⁴ might engage in some conversation with the King and Knight. The King would point out that a move like 1.Kd5 is useless ('I'm never going to catch that pawn!'),

while the Knight might remind the player of the White pieces of his agility in restricted spaces and capacity to threaten a perpetual check.

Position 10

This position is straightforwardly tactical. The question is, how far ahead can programs (or humans) see?

Some programs can figure out that White has a better move than 1.Qh5+ with a perpetual check, and would play 1.Rxd6! (human players who are less able to calculate in depth, but would like the chance of a full point, might go for this on the basis that, since the Black King is in a very exposed position, the draw would probably still be there for the taking if the mating threats petered out) Rxd6 2.Qe7+ Kg6 3.Qxd6+ Rf6 4.Qb8! b5 5.Bd5! Qb6 6.Qg8+ Kh6 7.h4 Qd6 8.Qh8+ Kg6 9.h5+ Kg5 10.Qg7+ Rg6 11.hxg6, and White wins.

The stronger programs find 1.Rxd6! but for quite a while may judge it only marginally better than 1.Qh5+.

The only idea involved here, apart from strong tactical calculation, is that of **pragmatics** - if the final outcome is over the tactical horizon, but we would like the full point, then 1.Rxd6 is worth a try, because we will probably be able to escape with the half point if winning chances fail to materialise.

Position 11

Moving the King should be good only for a draw. However, exchanging knight for bishop gives the chance of playing the c-pawn to c6, and now Black is in a static.

■ ¹⁴ See Note¹².

The downside is that Black acquires three passed pawns. The human player is not worried by this, since two of them are doubled and only one file away from the third. Therefore, the White King can mop them up and force the Black King to move, when Rxd8 is winning.

This is an easy one for humans, but the payoff is over the horizon for some programs which spend time wondering whether 1.Kh2 is better than 1.Kg1. Fritz 8 finds 1.Nxd5 in about a minute.

This is a straightforward example of a **static**, where sooner or later the player who is straight-jacketed by the c6 pawn will have to give up material. The problem is that the player of the White pieces has to be able to see that the threat of Black's passed pawns can be coped with.

Position 12

Here the problem is about falling into a static. This happens when Black goes 1...g3?? on the assumption that White will reply 2.Nxg3? or fxg?, when the game will be drawn.

But if the player of the White pieces is alert to the idea of the static, then the move chosen will be 2.f3! This gives up the e-pawn, but then the Black King is totally tied up, while the White King is free to roam, pick up pawns, create mating threats and win the game. E.g. 2...Bxe3 3.Ke2 Bd4 4.Kd3 Bf2 5.Kc4 Bd4 6.Kb5 Be3 7.Kc6 Bc1 8.Kd7, etc.

So what should Black do? The only way to hold on is to play 1...Bd8! Now, with g5 protected, 2.g3+ Kh3 is o.k., while a King march will fail to Ba5/e1/xf2 which draws.

This position defeats the programs which all

want to go 1...g3?? Human players worry about the resulting King position and look for something better - but don't always find it!

This is another classic **static**. The downside of the trapped position of the Black King is way off, but the human eye has no trouble figuring out that the day of reckoning must come!

Position 13

This position is given by Jonathan Rowson¹⁵ as an example of 'humour in chess'. It is taken from Short-Timman, Tilburg, 1991.

The point is that, in spite of all those heavy pieces lurking in and around the Black position, the way to win is to pick up the most vulnerable piece on the board, nestling safely on h2, and push it forward: 1.Kg3!

And now Black has no way of preventing the King advancing along the black squares and threatening mate on g7. 1...Rce8 2.Kf4 Bc8 3.Kg5. Here Timman resigned, depriving Short of the ultimate hilarity of winning with 3...Kh7 4.Qxg6+ Kh8 5.Qh6+ Kg8 6.Kf6!

The latest computer programs, which do not need a sense of humour in order to see an unlikely winning move, have little trouble with this, though it may still take them a few minutes to come up with the right idea. Humans, however, are less inclined to consider moves which involve marching their King up the board when there are still plenty of pieces on it.

We have here another example of a **static**, and in this case humans may have some problems applying **pragmatics** to it. But, since the fatal mating threat is not many

■ ¹⁵ See note ¹². Op. cit., 52-53

moves away, the programs see that 1.Kg3 is the way to go, and might not think it even worth an exclamation mark.

Position 14

In spite of those threatening White King's side pawns, Black can probably hold the draw after 1...Na7, but there is a much better move to be found in 1...Ba6!

White is forced to capture with 2.Bxa6, and now the a-pawn must queen after 2...a4 3.Kd5 Na5. Black just has to be sure that the White counter advance can be held after 4.f4 a3 5.e5 a2 6.de+ - which it can!

1...Ba6! is a very counterintuitive move to the human eye and, even if it came into consideration, it would be hard to be sure that the tactics would work out in Black's favour.

This is a position where the programs' command of **tactics** should come to the fore, and indeed Fritz 8 comes up with the right answer in about 2 minutes.

Position 15

In this position, White looks to be ahead. But the attempt to stay ahead by playing 1.Bd1 is misguided.

The best move is 1.Be8, when there is a safe draw after 1...Qe1+ 2.Kb2 Rxd2 3.Bxc6 Rxc2+ 4.Kxc2.

The problem with 1.Bd1?, of course, is that after 1...Qe1 it gets White into a horrible semi-static. Black just has to be careful about creating a position where freeing moves like Kb2 or Qf3 might work. Eventually, the Bishop can arrive on e3, leaving the h-pawn clear to advance to the queening

square. If either White pawn moves, Black simply advances the pawn on the adjacent file and maintains the blockade.

So, for example, 2.Ra2 Rd8 (putting the rook on a better square) 3.Rc2 (if 3.Qf3, then 3...Rxd2 4.Rxd2 Qxd2+ 5.Kb1 Qc1+ 6.Ka2 Qxc4+ 7.Qb3 Qxb3+ with a won ending. Or 3.Kb2 Qxd1 4.Nb1 (4.Nb3 Rd3 5.Ra1 Rxc3 6.Rxd1 Rxc4 7.Rd6 h5) Rg8 5.Ka1 Rg3 6.Qc2 Qd4+ 7.Rb2 Rd3 8.Qf2 Qxf2 9.Rxf2 Rd4 and again Black will win the ending) 3...h6 (now the h-pawn goes to a square where it is protected) 4.Ra2 Kg7 5.Rc2 Kf6 6.Ra2 Be3! (the key move. It cuts off the Queen from f3 and renders Kb2 impossible because of the reply Bd4) 7.Rc2 h5 8.b5 c5 9.Ra2 h4. And White can resign.

For programs the payoff is too far away. White may not have many moves available, but there are too many possible sequences of them and of Black replies. Once again, the human eye can see further than the program's algorithm. In fact, this position is a good test of how far programs can see.

At what point *do* they wake up to the fact that they are lost?

This is a good example of a **semi-static**. White has moves, but they lead nowhere. **Pragmatics** can tell the human player that it's better to give up some material and go for a safe draw.

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