JUNE 83

MICRO CHESS

ALPHABETICAL CHESS

Tony Harrington interviews Don Beal on the subject of his computer chess search theory inter alia.

Don Beal is not an entrepreneur or a supplier of micro-chess computers. He's a lecturer in the computer science department of the University of London's Queen Mary College. There may come a time, if all goes well with his research, when a Beal chess computer will come onto the market place. But that would be more or less incidental to his real interest, which might be described as the theory of computer chess programming.

I almost met Beal last September when he was due to enter the *PCW* tournament. His program was then running on a mainframe computer and he was struggling to transpose it to a micro. On the opening day of the tournament there was still some slight possibility he would succeed by the start of the third round. But he didn't. It was a great pity, since his presence would have considerably strengthened the amateur entry.

Among the computer science and artificial intelligence communities a certain dabbling in the problems of chess programming is fairly common. But Beal is unique in that his daily work as a lecturer – as well as his research – is concentrated to a large extent on computer chess search theory.

How did this come about? Beal learned his programming skills working for the Ministry of Defence before joining Queen Mary College. He played chess as a schoolboy and was reasonably enthusiastic about it – making the school team, and winning the school championship. When he went to university, however, chess quickly came to seem merely a way of wasting valuable time.

At the MoD his work with computers led to an interest in the potential of artificial intelligence. 'It occurred to me that chess would be an ideal field; a nice, limited problem with which one could investigate some aspects of AI. In fact, as I got into it, it turned out to be a huge problem,' Beal recalled.

He began a doctorate on computer chess, which he still brushes the dust off from time to time, and hopes one day to finish. And, since some portion of his teenage years had been spent mastering the secrets of electrical engineering, a few years ago he began to build microprocessor boards to turn his theories into practice.

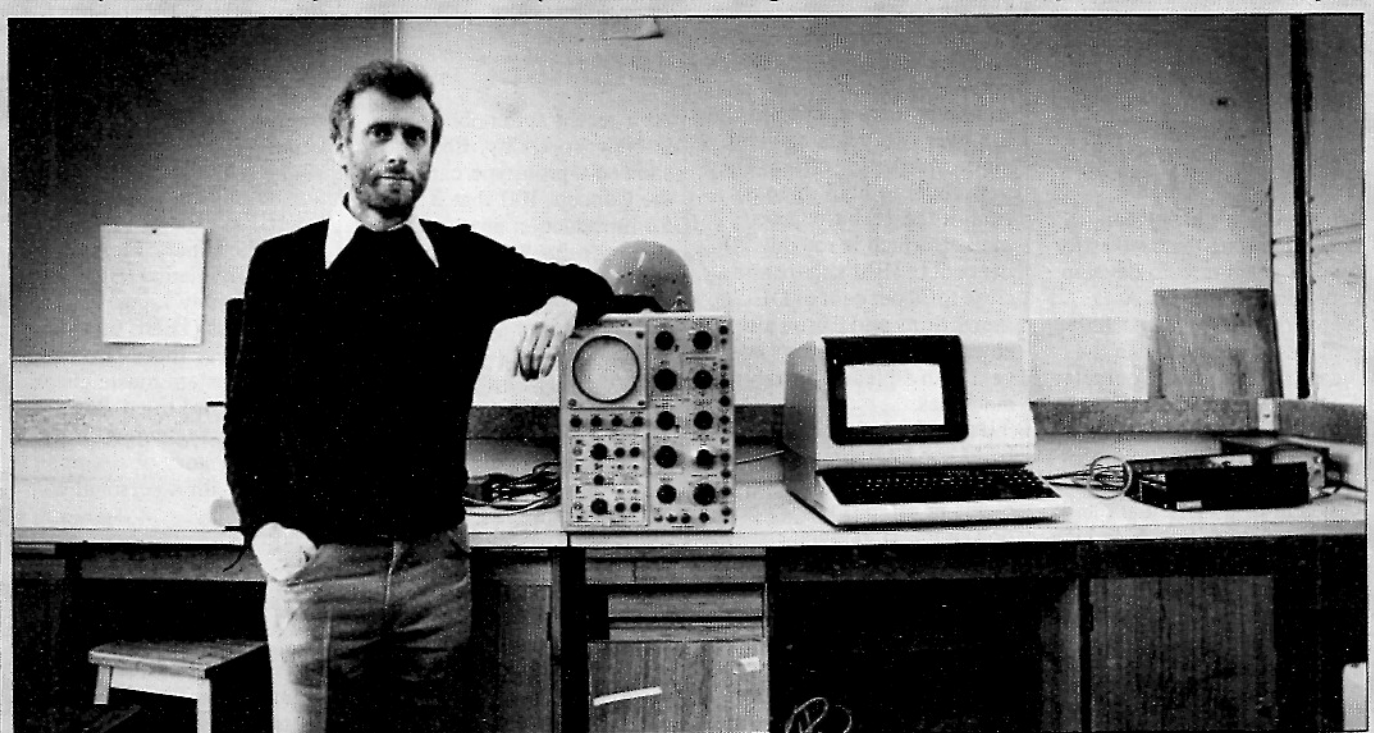
Most of the material that he works with is a closed book to me, and minimax search theory is not something to be picked up lightly in the course of an hour's chat over coffee. So those of you who have wondered from time to time how the machine does it when it nicks your rook unexpectedly, won't be much wiser by the time you finish reading this. That topic is one we will return to in another column another day.

Part of the problem is that the language used by Beal and his colleagues to talk about games theory bears a misleading relationship to English. I thought I followed reasonably well, for instance, when he explained his job at Queen Mary College. It involves, he said, some research into minimax theory, particularly the question of why it is that look-ahead systems result in better moves being played by the computer. 'For many years now look-ahead has been known to be effective in practice, but people have not made much progress in explaining in a convincing way, at the theoretical level, why this should be so.'

When he'd finished saying this, I nodded wisely and confessed to being totally baffled. Beal, it seems, has produced a reasonably convincing theoretical argument which does provide such an explanation. 'Does it mean there will be better chess computers?' I asked. 'Not really,' he said. 'It just explains why doing the things they are doing already produces reasonably good chess-like decisions.'

One piece of theory which might be of interest to readers new to this sort of thing did emerge from our chat. There is a well known algorithm in chess programming which saves a great deal of time without any risk that the short cut it produces will lead to the machine overlooking some vital move. It is called the Alpha Beta algorithm.

'The algorithm involves the idea of accumulating 'bounds' as the search pro-



Don Beal's chess computer is still in the assembly stage.

ceeds. As the program moves through the search tree, it locates a worst move sequence for white, and a worst move sequence for black. When you find this, there is no point in looking any further for an even worse sequence. Instead the program stops looking at move possibilities once they equal this value. In other words, it sets a bound or a limit on the search. At any moment in the search then, you have a best and a worst possible bound,' he explained.

The advantage is that where a standard search algorithm will go on to look at every possible move, using the Alpha Beta algorithm will save a very precisely definable proportion of search time. At its best, the algorithm will reduce the number of possible moves looked at (or search nodes, as they are called) to the square root of the number of moves that would otherwise be looked at. On a search sequence that would normally look at a million moves, for example, it will result in a thousandfold improvement (ie, the program will only need to scan 1000 instead of 1,000,000 search nodes).

How well all this theory translates into practice can be seen in the games section where one of Beal's program victories can be studied at leisure, together with David Levy's comments on it.

Beal's own micro is still in the assembly stage, and when I spoke to him, he thought it would need a month or two's 'uninterrupted work' to be brought to full tournament strength. The heart of the machine, Beal says, is a piece of fast sequential logic. 'This bit of hardware is what makes it different from the Thomas Bell hardware (Belle). Belle is a huge piece of hardware. Its inventor calls it portable, but it weighs about 60 pounds and you have to be dedicated to carry it about. My machine is about the size of the usual hard cover book and it will have around one quarter of Belle's search speed,' he explained. ('One quarter' might sound like a modest development, but it should be enough to make Beal's machine an absolutely formidable opponent. It would give it a much faster search speed than any of the current commercially available micros.)

Beal has used some very expensive chips in the construction of his machine, and working on the usual rule of thumb that a retail version should cost four times the component price, it would be priced out of the range of all but the wealthiest chess enthusiasts if it ever came to the marketplace.

At least, that is what he thinks at the moment. But if it ever gets out of its academic environment it might well find a businessman to get the production lines rolling and the prices down.

Games section

White: BCP; Black: 'Strong player on an off day' Sicilian Defence: Notes by David Levy

1 e2-e4 c7-c5
2 c2-c3

(This move has become extremely popular in recent years. Its chief merit is that it avoids the volumes of openings theory that have been written about the Sicilian Defence, but it must also be said that the move c2-c3 is not so easy to meet as might first appear. White threatens immediately to establish a powerful pawn centre with d2-d4.)

2 ... Ng8-f6
3 e4-e5 Nf6-d5
4 d2-d4 c5xd4
5 Bf1-c4!?

(An interesting gambit. White offers a pawn in return for a lead in development.)

5 ... Nd5-b6
6 Bc4-b3 d4xc3
7 Nb1xc3 e7-e6

(Blunting the attack along the b3-f7 diagonal.)

8 Ng1-f3 d7-d5

(This move may be playable, but I think it possibly premature. I would have played 7...Bf8-e7, followed by ...0-0, and only later try for ...d7-d5.)

9 e5xd6 e.p.

(This *en passant* capture leaves White without the cramming influence exerted by his pawn on e5, but in return it (I almost said 'he') develops a strong initiative.

9 ... Bf8xd6
10 0-0 a7-a6?

(Black was worried, with good reason, about the possibility of an eventual Nc3-b5 by White, but the text wastes too much valuable time, and allows White's initiative to grow even more dangerous.

Better would have been 10...Bd6-e7, or 10...0-0, or 10...Nb8-c6.)

11 Bc1-g5 Qd8-c7?

(Black should have played 11...Bd6-e7, and if 12 Bg5xe7 Qd8xd1 and 13...Ke8xe7, with an extra pawn and few real problems. Note that after 12 Bg5xe7 Black cannot recapture with the queen because of 13 Qd1-d4, forking the pawn on g7 and the knight on b6. This theme recurs again during the game.)

12 Ra1-c1 Nb8-c6
13 Nc3-e4 Bd6-e7

(Black was by now torn between the devil and the deep blue sea. The other retreat, to f8, would have left White with such a commanding lead in development that it would have been extremely difficult for Black to survive. Nevertheless, that is the course that I would have followed, because now Black loses castling rights for good.)

14 Bg5xc7 Qc7xe7
15 Ne4-d6+ Ke8-f8
16 Rf1-e1 g7-g6

(Hoping to escape with the king at g7, but he should have tried ...h7-h6, possibly followed by ...Kf8-g8 and ...Kg8-h7.)

17 Nf3-d4 Nc6-a5
18 Nd4xe6!

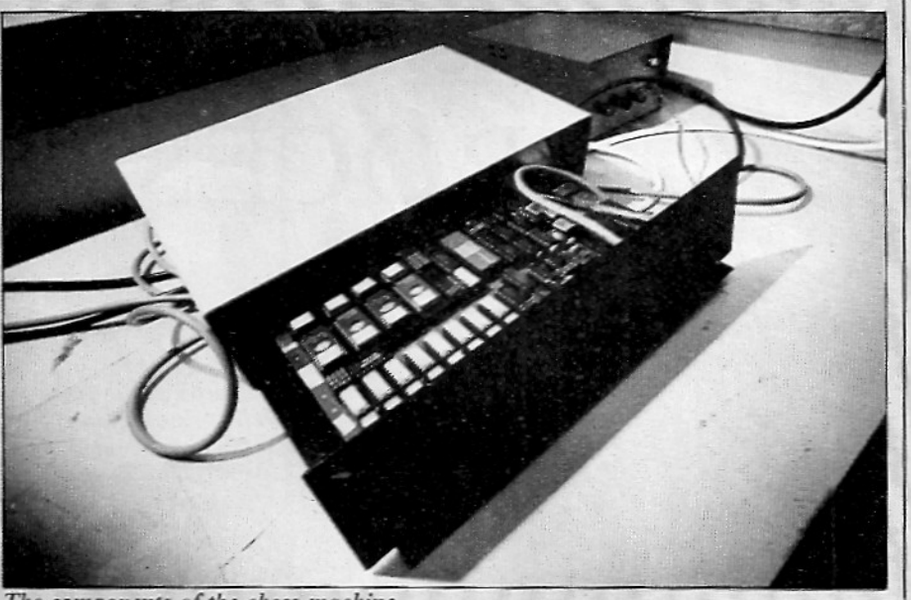
(The first surprise. White wins back the pawn with a little combination.)

18 ... Bc8xe6
19 Qd1-d4 Rh8-g8
20 Bb3xe6 f7xe6
21 Rc1-c7!!

(Simple and decisive. If Black captures the rook, White's queen comes in on f6, forcing mate.)

21 ... Nb6-d7
22 Rc7Xd7! Black resigns

(Again the capture of Black's rook allows 23 Qd4-f6+, with mate next move. A convincing display by White, fully justifying the pawn sacrifice in the opening.)



The components of the chess machine.

A short apology

Before my post box is crammed with letters pointing out that Hegener and Glaser do not make a machine called the Roman II or even the Roman III, let me explain how these mysterious machines came to find their way into last month's column. Some thirty lines of copy were added to the article rather late in the day. I painstakingly read these lines out to a kindly colleague down the other end of the telephone line. To make sure that no mistakes occurred over the phone I said, when I came to talk of the Mephisto III, '... the result, in the Mephisto III's case – that's Roman iii, not arabic, got it?' 'Yes,' said my colleague, and wrote: 'The result in the Mephisto and Roman III's case is that it now plays a very intuitive game.' Those of our readers with sharp eyes and long memories will have noticed that the same fate befell a comment made on the Mephisto II a little further down the column. May we respectfully hope that those of you who fell off your chairs laughing at us didn't bruise yourselves too badly! END