

## NEWS, INFORMATION, TOURNAMENTS AND REPORTS

### AN INTERVIEW WITH RICHARD D. GREENBLATT

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*H.J. van den Herik*

[Richard D. Greenblatt, Guest of Honour at the 7<sup>th</sup> World Computer-Chess Championship, granted an interview to H. Jaap van den Herik, whose questions are in italics. An edited transcript follows below.]

*Can you let our readers have some of your background?*

"I am Richard David Greenblatt and I was born in Portland, Oregon on Christmas Day, 1944. I came to MIT in the Fall of 1962 as an undergraduate student and the following year I got interested in computers. After another term I withdrew from MIT and after briefly working at another company, I returned to MIT as a researcher. I basically did some work to chess programming. I also did a bunch of other things. So they admitted me as a graduate student."

*What about degrees and such?*

"No degrees, none. Well, ... other than high school. Basically, I did not graduate as an undergraduate. I also did not graduate as a graduate student. I could have submitted my chess program as a Ph.D. thesis but I did not. But I *did* then become principal research scientist in the MIT Artificial Intelligence Laboratory. Putting dates on it, 1962 I started, ... and I essentially left school in the Spring of 1965. I returned to MIT as an employee initially in the Fall of 1965 and I was with MIT then until I eventually left to form a LISP-machine company in 1981. I had several promotions during that time, but I basically became a principal research scientist in about 1978 or so."

*How did you pick up the idea of chess programming?*

"Well, I had played chess quite a bit in grade school and in high school. I grew up in Columbia, Missouri, which is a university town and when I was a grade-school kid I used to go to the Student Union and play chess with the university kids."

*So you were a chess-player yourself?*

"So I was a chess-player. In those days there were no USCF ratings or anything in Columbia, Missouri, so I was not officially rated, but I was probably fairly good. When I came to MIT, I did not do chess, but in the Fall of 1966 I went to the Fall Joint Computer Conference. In those days we used to have two big computer conferences in the year and the Fall Joint Computer Conference was in San Francisco. I visited at that time the Stanford Artificial Intelligence Laboratory which was a kind of laboratory like the MIT Artificial Intelligence Laboratory. And at that time I examined listings of a game that was in progress between the Kotok program (which had been taken to Stanford by John McCarthy) and a Russian program. By examining the listings I could see that the Stanford play was very poor. So I resolved to go home and do better. I had it playing chess within a month and we played our first chess tournament in April the following year, so about four months later."

*That is quite a performance, as we all know. And then, in the Fall of 1967, you also presented a paper with Eastlake and Crocker?*

"That's right. So that was one year later, that was at the Fall Joint Computer Conference the next year."

#### **Human tournaments**

*How did you come to think of entering human tournaments? You were the first to have this idea.*

"Well, basically it was just a natural thing. I have always thought that that was the best way to evaluate a chess program, to let it play with humans. And from the artificial-intelligence point of view I thought that would be best. I thought that chess programs simply playing other programs could lead to certain distortions in the play. ... I simply decided to do it. Another aspect of it was that, after I had the chess program sort of initially playing chess, two strong chess-players who were students at MIT began hanging around at the laboratory and I had some interaction with them. One was Alan Baisley and the other was Larry Kaufman."

*What happened to them?*

"Well, Larry Kaufman prepared the opening book and so he played a number of games with the machine to try to analyze what lines it played best in and to design the book so that it would go into those lines as much as possible. Alan Baisley also played quite a few games and he also wrote a chess program, a form of the so-called Technology program that had been written earlier at Carnegie. So he was around too."

*Coming to the present, what ELO rating is the strongest program at the moment, do you think?*

"Well, I haven't been following chess very closely for a number of years, just occasionally from time to time. Basically, you know, I don't have a strong opinion on that right now."

*And where do you think Kasparov stands?*

"I guess around 2750. No, I don't know exactly."

*Did you ever play seriously against the program yourself?*

"After I had initially written the program I then went through a phase where I read a number of chess books. I read Alekhine, I read Botvinnik, I read various Russian chess books. I never played seriously in tournaments, I never really thought that was a good use of my time. But basically I became a pretty good chess-player, such that in over-the-board analysis I could more or less hold my own with Kaufman and Baisley, maybe they were a little better than I."

*Did you play your own program?*

"Well, not in a formal sense, but informally many times, just to see what things it would do in individual positions and so forth."

*And what was the result you remember?*

"Basically I think I was a better chess program than the program, although of course if I made mistakes, it might get an advantage." [grins]

## **Human opponents**

*What about your program's famous human opponents?*

"Well, I was not actually present at the most famous games, but they certainly were those against Dreyfus and against Fischer. Against Dreyfus, I don't remember the exact date, it must have been some time in 1967. Gerry Sussman who was a student at that time, later and now a professor at MIT, brought Dreyfus over to the lab and they played a game right in front of the machine and the machine suitably won. I mean that was an event. One of the things chess has shown, in matter of fact maybe the major thing that chess has shown, is the kind of cut through the bullshit, as I would say, that surrounded this whole subject of artificial intelligence and human performance and machine performance and so forth. This guy Dreyfus was a famous critic, a so-called debunker of artificial intelligence and his points were based largely on ignorance and metaphysical things. In any case, the program playing him and him losing to it, I think, was a fairly important stage in the enlightenment of a certain segment of philosophers. Dreyfus had kind of tuned down his criticism, but a few years later he came out with another alchemy-and-artificial-intelligence type of paper. The last I heard of him, I think he is at Berkeley now, but he visited MIT maybe 4 or 5 years ago and gave a lecture that I heard. At that time he was designing an expert system that had to do with flight pilot training or something under a contract. For what it's worth: if emulation is the most sincere form of flattery, then Dreyfus has become a convert to Artificial Intelligence, though I'm sure that's not what he writes in his books."

*Have you ever had a debate with Dreyfus?*

"No. Seymour Papert did. ... Seymour Papert had several published official debates with Dreyfus."

*There is a "famous" debate in the SIGART, Newsletter, which published the game with only a part of Dreyfus' comments implying ...*

"That's right, of course. One of the primary things was that both philosophers and early computer-chess programmers had no idea, even remotely, what the game of chess was all about. So they went on at great length in a state of total ignorance. I suppose that my contribution of a certain sort was to come along and say, we really have to count our pieces in this game. We really have to search a reasonable number of moves, basically

like the early Kotok program with searching widths of 4, 3, 2, 1 and, you know, had no plausible-move generator at all. The settings were just a guarantee to produce complete randomness, just those regardless of anything else the program might have to do."

### Milestones

*Excluding your own work or the debate with Dreyfus, what do you consider as milestones in the development of computer chess?*

"Well, I don't know. I haven't been too closely involved in it. I did pursue it for some years, but I also was involved in a LISP machine after that and I got really more and more involved in that, so I really had not very much time to carry through properly on my computer chess, so I never did and I followed it less and less. I think the normal milestones are the Northwestern program, Belle, Hitech, and Deep Thought."

*Widening the field to Artificial Intelligence as a whole, what do you consider as milestones there?*

"Well, that's quite a long story, because I'm afraid Artificial Intelligence is kind of in need of a regrouping right now, the pendulum is swinging back and forth rather wildly, shall we say. So, right now, I'm not sure there really have been many milestones. There have been mild twists and turns to no real long-term effect. I don't believe that as of today there is any serious artificial intelligence that I have seen demonstrated in any way whatsoever. There have been a number of minor things of one sort or another, but I also don't believe that anyone, with very, very few exceptions, has even made an attempt to seriously demonstrate artificial intelligence. I think the only serious attempt probably in the whole US right now is the CYC program at MCC; it's pretty sad that that seems to be the case, but maybe it is."

*I come back to your program's opponents. Shannon told me that he was also one of them.*

"Well, the program was later distributed quite widely. It was available on our PDP-6, which was a time-sharing system and which had open access, and anybody could dial into it. It was also distributed by DEC with the PDP-10 operating system and available quite widely around the world. So, hundreds and probably thousands of people played it and they probably occasionally still do to this day."

*Some of the games are recorded. For instance, the Fischer games are recorded. He played three of them, did not he?*

"I think so. Again, I don't know. I wasn't there at the time and what was recorded is recorded, but I really don't know anything about it."

*But you must be happy that Fischer played your program, or not?*

"Well, it's sort of nice, but I don't really have any great feeling either way. A number of Masters did play the program that I was aware of, because I analyzed the games and so forth. Bent Larsen came to Boston once and I had a discussion with him and he played some. Among the Masters of course, there were Kaufman, Baisley and a fellow named Carl Wagner, all three were National Masters and students at MIT. The program also played several masters in human tournaments that it entered. They were Swiss-system tournaments and it would typically get paired with a Master just about every tournament."

*What was the reason that you did not participate in the 1<sup>st</sup> ACM tournament?*

"Basically I was not particularly excited by the idea of computer-vs-computer chess. That plus the fact that I was busy at that time I think are the two reasons. I felt then and I still feel now to a great extent that it is better for the field if anybody can go to the local tournament and play any time when ready. This whole thing, where there is an event once a year, and you come in and you play 4 or 5 games, is not a particularly positive situation. But on the other hand I also understand that from the point of view of sponsorship and people's interest and so forth, maybe that helps promote the game and promote computer chess."

*Looking back, don't you think it is a pity that you did not compete in the 1<sup>st</sup> ACM tournament?*

"No, I don't."

### Computers unlimited

*What do you think about computers and the future of chess?*

"Well, again I'm not very much up, but as far as I have seen I think there still is a serious question: Will brute

force really be enough to beat the very top players? Or will it require some sort of smart conceptualization or any such a thing?"

*What is your idea on this?*

"Well, I think there is a very big chance that conceptualization may be required. But on the other hand, like everyone else, brute force has got a lot further than we thought it would. We might be wrong again. I'm a little more cautious in saying that than I might have been a few years ago."

*How strong do you think the programs will play in the future?*

"I don't really know. It's a little bit of an open question in my mind if a program really has a true grandmaster strength, – if it is really true that today a computer can go on in tournament circuits, play day in day out and achieve the grandmaster norms. I don't know. I'm a little bit skeptical about that, although I guess theoretically maybe it's true that that level of performance has been achieved."

*What do you think about the increase in level?*

"I think that's the thing. There is no doubt that computers can be made faster and will be made faster. So there is no doubt that a factor of maybe as much as a hundred is easily obtainable. So there is the question of whether that amount of brute force will be sufficient to move it up. I guess you have to say that there are probably three notches left to go: a sort of grandmaster, world-championship contender and world champion. Each one of those represents a kind of level."

*And how far do you think they will reach?*

"I do not think there is any reason why it would stop at any particular level."

*So in the long run they will defeat the World Champion?*

"Sure."

*But what about solving the game?*

"Strictly solving it is truly unlikely, I think. I guess it depends on if a forced win can be found for White, that might be a notch. If it is going to be a draw then actually proving it is a draw may seem obvious, but actually to *prove* that is the fact ..."

*So that's still an open question?*

"Yes. In other words, if someone can demonstrate a win, that reduces the search, because of the alpha-beta; you have only one move at each position, the total tree that has to be enumerated remains somewhat manageable. It probably won't be a completely exhaustive thing, but on the other hand it will probably be comparable to a large chess encyclopedia, except more authoritative, based on more work in fewer areas."

### **Computer chess in the human market**

*What role do you think computer chess should be allowed to play in the chess world?*

"I'm not in favour of any limitations. So basically: whatever you can do. People want to enter chess programs in tournaments and do whatever they can. I think they should be encouraged to do that."

*That they will play in normal tournaments, all right. But do you think it will be possible to have them in national team championships?*

"I don't see why not, although I guess that the idea of a team of computers is a little bit different, because they can obviously be duplicated and they don't have a separate identity like humans, so there might be a question of whether multiple copies of one program should be allowed to form a team or not. I don't take a stand on that."

*Do you agree to let a computer play in a zonal tournament, so that it would climb and finally play against the World Champion?*

"That seems the best way to do it: let them come through the ranks like anybody else. Again, whether FIDE and the powers that be in chess will permit this is far beyond me."

*Have you seen that there was some ruling in the last ICCA Journal?*

"Whatever the ruling, I think, ideally, the chess computer should compete on a completely even basis, being neither favored nor inhibited as compared to a human."

*Don't you think all this would affect the chess-player?*

"No, I don't. Although, of course everything is affecting not only the chess-player, but the citizen of the world and every other kind of being that exists on this earth right now in this time of rapid change."

*What do you think might be the influence of computer chess on professional chess-players?*

"My guess is that they will make more money, analyzing chess games and otherwise, because chess is promoted and so forth. I think that is probably been true up to now, although I don't know if anybody has any statistics; it's probably not the largest effect. The largest effect is probably Fischer and things that have to do with Fischer. But I think that computer chess has turned into a marketed product, with some hundreds of millions or billions or who knows how many dollars' worth being sold so far."

*But what if computers outsmart human beings?*

"I don't think it will make any great difference. But again you will never know. Each person will react to it in different ways and you know there are very few people who are not outsmarted by computers anyway right now. So, as far as the average player is concerned, the situation is not going to change vastly from what it is now."

*Have you any idea why anybody chooses chess as a profession?*

"I think it is just because they can make money out of it, win money in tournaments and so forth. As far as money in tournaments is concerned I do favour passing over the chess programs. And as far as the actual dollar prizes are concerned, I don't think the computers should win any of those, because of the economics and so on. On the other hand, I do think they should win the trophies if they qualify for a trophy."

*Do you think that a person having to choose between being a university graduate and a chess-player will be influenced by his knowledge that there are chess programs playing stronger than he ever will?*

"Yes, it already influences people. I know a couple of people who are strong in the chess world and still decided to enter the academic world. I think that will continue to happen. Actually I think it is very pronounced in the US. Think of Robert Tarjan, a fellow who might have a chance to become at least a professional chess-player if not a World-Championship contender. He is now working in mathematics. Still I think that just being a full-time chess-player is done out of love, and people will continue do that anyway."

### **The human use of computer chess**

*Now let me shift to the use of computers. You agreed to allow computers in preparing for matches, and in theoretical reviews, because you said they should play a role whenever possible. But what about correspondence chess?*

"Again I don't see any reason to restrict them. Correspondence chess takes such a long time that from the research point of view I think its interest will be somewhat limited. I don't see that there is a problem. ..."

*We also have chess problem-solving competitions.*

"The problem here is that they are already at a point where a computer would win any such competition."

*Is there any field you would deny to the computer?*

"The only thing I would say no to is winning money, in any form. Basically, in competition for prizes they should be passed over."

*About the possible contribution of chess-players to computer chess, do you think that in future there will be cooperation between professional chess-playing and the development of computer chess?*

"Yes. Actually, I don't know if they have to be professional chess-players, but if they are it probably helps. For one thing, they might just play the programs. For another, there is what Hans Berliner does, which is a detailed analysis of opening variations by computer combined with his own deep analysis. This means preparing

opening surprises for particular opponents and in particular lines. I'm sure that computers can be a great aid in that."

*Do you think that chess professionals can help the programmer to bring in ideas?*

"Sure. Basically they play the games and I think they can therefore offer opinions. I don't think, though, that it is necessary to have chess professionals. I think that most chess professionals that I have known have also been just smart open-minded people in general. Whereas they have been quite valuable in the development of chess programs, I would not necessarily ascribe that exactly to their chess talent. I'm not sure that a grandmaster would necessarily be better than an international master of chess, because of the fact that he was a grandmaster. Bringing in the ideas is a talent in its own right, as is a talent for speed chess."

### **Common sense not mastership**

*You yourself were not a good chess-player when you started with a chess program. But do you think the major programmer of a chess program has to be a chess-player himself?*

"In those days there was a firm need for it, because the level of misinformation and mystery and myth that was built up around the game was so great. But on the other hand actually it was not necessary to be a chess-player. You had Botvinnik who was World Chess Champion. He wrote this whole book about what it was to play chess and it came down to his move in the Botvinnik-Capablanca game. That is not what computer chess is about. So it is a certain amount of common sense, just level-headed sensibleness, which is required. If you know something about chess that helps and if you are basically reasonable that helps too. Nowadays, a certain sophistication has to be added. On the other hand, you can read some books, you can play some games, you can subscribe to Chess Informator, you can do this and that, and I'm sure you can then write good chess programs. And if you never played in a tournament game, who knows how good you would have been if you *had* played in a tournament game."

*In fact Botvinnik was an exception, because he was the only ex-World Champion who started to build a program, next to Euwe's minor effort.*

"True enough. Actually, I think at that particular time he probably inhibited and not promoted programming. I don't know the dynamics then going on, but basically he was so far ahead of the program that he almost despaired of the possibility. Well, actually he had almost the same view as the early McCarthy and some early chess researchers, who were very romantic about chess. Botvinnik was almost as romantic in completely the opposite way, but then withdrew to his former position. His example was that wonderful combination, but why should anyone want to find just that combination? The central thing is how to play chess, how to make reasonable positional moves, how to hold on to all of your pieces. How we do that stuff was the question it was needful to look at."

*Your first paper with Eastlake and Crocker was not followed immediately by another publication. Why?*

"Well, I have not really been a publication-oriented researcher. This is probably legitimate criticism. That's just my style. I am pretty much of a hacker. So I like to *do* stuff. I do actually write internal documentation very often, but I seldom have got it published. Also, I've actually had a couple of things written of significance that were turned down by referees. I have a reputation in certain circles of being a counter-cultural figure. I believe the one that I tried to get published and was turned down is the Moby-Memory paper. Anyway, it was partly my fault: I did not get it in on time, they would not accept it a few days late, and so on. Anyway, I did not make probably as much effort as I should have to get things published."

*And then you came up with the CHEOPS idea?*

"Actually that was Ed Fredkin, who is a professor at MIT and who was at that time just becoming Director of project MAC. The particular setup at MIT was that there was the Artificial Intelligence lab and there was project MAC. These were two separate laboratories at that time in the same building, which had a history of working closely together and people moved back and forth between them. Fredkin had been in the AI lab, he then went over to project MAC. He had an idea of how it might be possible to make an array and an initial drawing of what the logic in a square might look like, and what should be on the inputs and outputs everywhere. He gave that to me. I picked up the idea and worked it out just enough to make it work. And then another fellow who was there, named John Moussouris, who was a Rhodes scholar at MIT, picked it up and did a lot of the design and made CHEOPS. And then I wrote the software for it."

*And then you wrote also an article for Machine Intelligence 9?*

"That article was written principally by John Moussouris."

*In the computer-chess world we all thought that you returned to our world with a brilliant idea.*

"Well, it was a good idea. It was clear that it was necessary. The particular history of it was that Fredkin became project manager. We submitted a request for \$50,000 to make a prototype."

*What does MAC in project MAC stand for?*

"For Multiple-Access Computer, or Machine-Aided Cognition. Originally the AI laboratory was the AI group, part of the project MAC. At some point the AI lab split off, became a separate laboratory. And then at some later point, the project MAC was renamed the Laboratory for Computer Science, which it is today. Next Prof. Michael Dertouzos, who is the present Director of LCS, came in and as his first act he gave us the \$50,000. He gave it, no questions asked. Just bang, OK, here it is, which really dumbfounded us, because at that particular time the administration of Project MAC was in disarray."

### **LISPs and Labs**

*Then you had the money and so you could start?*

"Then we had the money. We actually took half the money and built CHEOPS. We also took the other half of the money and we built the prototype LISP machine. Both of them were built with similar technology, so the machine-aided design, the tools and the kind of construction and many other things were shared between them."

*And then you abandoned the idea to let it play chess?*

"Both projects went forward and both projects got fairly far, but it is true that the LISP-machine project was more central to Artificial Intelligence and it had commercial aspects. So it took more and more of the time and it is true that eventually we really had not enough time to properly develop CHEOPS. The other somewhat unfortunate thing about CHEOPS was that, although the main machine got built and the destination array and the origin array, which were two large arrays, were built too and worked fine and were supported by software, the hash table that was planned never was built and that was an important omission. This meant that it was hard to do what might have otherwise been done with the machine."

*What happened next?*

"Both projects continued at MIT for quite a number of years. I guess I started the LISP-machine project in 1973. For years, I was the only one to work on it. I think it was about 1974 when we actually started with the hardware. It probably took about a year or so to get CHEOPS initially built, so probably around 1975. Then through 1976-1980 we were working on these projects. The CONS machine [*cons* standing for the constructor operation in LISP] was just one of them. The second machine was called the CADR [pronounced *cudder*, also a LISP notion] machine and we built a total of about 35 of them at MIT. We really had a significant hardware-manufacturing effort going on, probably the largest one that ever has been at MIT, either before or since. For a while we were actually making CADR-machines for researchers. If you were at MIT and you had a research grant and you wanted to spend \$50,000 for a CADR-machine, we would make you one. As a result of that the machine eventually became pretty well-developed and it led to the formation of companies and yet more companies spinning off."

### **Doing not Turing**

*Let us turn to Artificial Intelligence in general. What do you feel about the Turing test?*

"I'm not very interested in the Turing test. I think it is artificial, it is a game and it is not important. So I don't really care very much about the Turing test. I think it would be a misallocation of effort to try and meet it. I am much more interested in actually doing practical things. Whether it seems like it is a person doing them or not, I don't care."

*One more background question: What do you think is the fundamental difference between reasoning by a machine and reasoning by a human being?*

"Well, of course, reasoning by a machine depends on its programs and as of today we don't really know how to make programs that do reasoning. Well, I think access to printed material, in the English language, would be a

great big milestone. That's the one that I think is probably most interesting right at the moment to go for. And if that's achieved, then we will see how we continue from there."

*What about differences and similarities?*

"Right now the difference is that people reason and machines don't. Seeing that difference there are very few similarities."

*Let me hark back to a discussion with De Groot on intuition. Could it be incorporated into chess programs or couldn't it?*

"Well, intuition is a lot of things, but you could say that chess programs already have intuition, since they have positional biases built up in various ways we do not fully understand. These biases cause the program to follow certain lines. Whether you can call this intuition, I do not really know." [grins]

*What about creativity?*

"Well, I'm not so concerned about creativity. I do think that conceptualization is important. There is a certain reduction of experience to centralized facts, which I think is definitely interesting in its own way and crucial. Whether it is necessary for chess or not is an open question. Maybe it isn't, in a brute-force method it may not matter. But certainly for natural language I think conceptualization is a very important thing."

*Speaking about conceptualization, do you think that in future a computer will be able to write a chess program?*

"I don't see why not. I think there are some that claim to do it already. I don't believe that, but it all has to do with how you represent the rules of the game. It boils down to a question of definition. If you represent the rules in a sufficiently precise form, then it is more or less trivial to write a computer program to translate that into a program."

*Do you think that the results of computer chess are applicable to broader fields?*

"Apparently, only somewhat. The results in computer chess so far have been: (1) let us apply realism rather than romanticism to the task; this attitude profitably carries over to all fields; (2) brute force can almost beat the World Champion and can beat some grandmasters; the big question is of whether that is applicable to other fields: I think there are many reasons why brute force has had a relatively easy sway in chess and that we will find it harder going in other fields. This particular result in chess does not carry over so well."

*From chess or from the beginning of checkers there also arose the idea that a computer program could never be stronger than its creator.*

"That of course is completely nonsense. It has no basis in anything."

*And that applies also to other fields?*

"Well, I don't know exactly what you mean by other fields, but, yes, I would say that it does. I can't imagine what the connection is between the strength of the programmer and the results of the program. There is clearly none. It helps for the programmer to be a reasonable and reasoning person, but that is a completely different thing from the programmer being a strong player."

## Literature

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