Oral History of David Levy

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Monty Newborn: We're here with David Levy, a long-term friend of mine for over 30 years. A leading writer in the field of chess and computers, an international master himself, President of the International Computer Games Association. But my mission now is not for me to talk, but for him to talk. So David, could you tell me about how you got started in chess?

David Levy: I learnt the moves when I was eight from an uncle who had been a big player I think in the army, or the armed forces in the UK. And I was told that he was army champion. I don't know if that's true, but he was very enthusiastic, and he taught me the moves, but very little else. And then my father saw I was quite enthusiastic about it, so he taught himself the moves, and he bought some books and magazines, and he used to play with me a bit, and he used to play through games from the magazines with me to encourage me. And that's really how I got my first interest. But I wasn't really serious until I was about 11, and then when I went to what you call high school, my best friend at school, by chance, his brother was captain of the chess team. And this was a school which happened to have a very strong chess club and chess team. It was one of the best in the country. So Eddy, my friend Eddy, and I used to play chess everyday after school. And we used to go to the chess club at school, and then I lived near the school, so he'd come home with me, and we'd sit in my bedroom playing chess, and my mother would bring us sandwiches and cakes, and Eddy ate all the sandwiches and cakes, but I sort of spent my time concentrating on improving my chess. He started out a lot better than me, but within about a year I was as good as him or better, and then I started playing in tournaments.

Newborn: So this was 11 or 12 years old when you realized you had some talent, more than just playing with friends.

Levy: Yes, I think I'd just turned 12 when I played my first tournament. And it was the under-14 championship of my county, which was Hertfordshire in England. And I remember I won the tournament with nine-and-a-half out of ten. In those days, of course, you'd play, especially juniors, we played very quickly. I mean, most of the games were over in about 15 minutes. But I remember from, I think it was the penultimate round when I was leading the tournament, and another boy got a completely winning position against me. And he was several pieces up, and he stalemated me and he burst into tears, because he was unhappy that he only drew. So that was the only game I drew, and I managed to win the tournament. And that really gave me a lot more enthusiasm.

Newborn: So between then and when did you become Scottish champ --there were some milestones on the way? Maybe mention a few?

Levy: Yes, I played in a lot of junior tournaments in the UK, particularly in the London area. I played in my junior county championship and won every stage. As I got older, I went into the under-15

championship, which I won. And then I won the under-18 championship, and then I progressed on and played in the South of England junior championship, which I won in 1963. I think I won it in the same week that Gary Kasparov was born. So by the time he was born, I was already a reasonable chess player, but he sort of caught up on me eventually. And then as a result of winning the South of England championship, I was picked to play for England, we used to have a -- I think it's still going -- there's a junior tournament between England, Scotland, Ireland and Wales every year. So I played on the English team when I was 18. But then I went to Scotland, I was at the university of St. Andrews, and I remember when I turned up there first day, the sort of "Freshers Week", they have what they call a "Freshers Fair", where all the clubs tried to get new members. And I was wandering around the Freshers Fair trying to find things to interest me. And I saw that there was a chess club at the university. And so I wandered over, and somebody said, "Do you play?" And I said, "Yes." And they said, "Well, if you play our club champion, if you beat him, you get a banana." So I played the club champion, and I won the banana.

Newborn: That was your first major wager.

Levy: That was my first. <laughs> Well, it was okay, because if I'd lost, I wasn't going to lose a banana. So I thought it was a pretty good deal. And they said to me, "Who do you play for?" And I said, "I played for England." So they said, "Oh, that sounds good. We'll have you on the team." So then I got in the university team, and that was very nice. And as a result of that I got picked to play for Scotland in the World Student Championship, which is a team event held every year. And I played in that first in Romania in 1965. And that was really nice. I'd already played in one international tournament; I'd played in the US Open Championship in Boston in 1964, and I scored, I think, about 50 percent. And one of my games was a draw with Walter Brown, who subsequently became US champion and a grand master. And also in 1964, I played in the New York City Junior Championship, which was won by Andy Soltis, who's now one of America's leading grand masters. Walter Brown was second, and someone called Mark Yoffie was third, and I was fourth. And so I was already getting reasonable results in tournaments. And then, as I say, I started playing for the Scottish student team. And first time was in Romania, in the mountains -- the Carpathian Mountains. It was beautiful in a small town called Senia. And that was really - it was like a sort of Olympic game for student teams in chess. It was a very friendly atmosphere. There were no prizes. You just played for fun and for the honor of representing your country. And that was when I got my first real taste of international chess. And then after that I got stronger, and I got selected for the Scottish student team, I think six times in total. And then in 1968, I competed in and won the Scottish championship for the first time.

Newborn: Do you remember what your score in that championship was?

Levy: I don't. I remember I won it...

Newborn: Did you overwhelmingly win, narrowly win?

Levy: I don't recall winning-- I didn't win by an overwhelming score, but I won convincingly. I think I managed to defeat most of my main rivals, or draw with sufficient of them that they were behind me. I think I more or less won the tournament with a round to spare or something like that. And I was never in trouble in the tournament.

Newborn: You became International Master officially in 1968? I mean, you were awarded the title?

Levy: No, I got the International Master title in '69. What happened was, it was completely unexpected. Because I was Scottish champion, I was selected to represent Scotland in the FIDE Day World Championship elimination cycle. The World Chess Federation has a whole series of elimination tournaments to decide who can compete for the world championship. And I played in what was called a Zonal Tournament. The world is divided into areas called zones, and in every zone you have a tournament. And the top 70 from each zone go forward to the next stage, which is called the Inter-Zonal. And because I was Scottish champion, I was picked to play in the Zonal Tournament for Scotland, which was a great honor. I went along just expecting to enjoy myself and finish in the bottom two or three places, because Scotland was a very weak chess country, and we always finished in the bottom two or three places. It was quite a fun event, because I played in Portugal in a seaside resort called Pride of the Russia. I actually learned to swim there. One of the other players from-- I think he was from Rhodesia actually -- he taught me to swim, which was very useful. Anyway, I started off, and I didn't really prepare specially well for the tournament. I took with me a few opening books, and I took a few copies of Informata I think it was up to Informata 7 by then, which is a six-monthly publication that includes all the latest games. So I could see what openings my opponents played. I prepared for every game fairly thoroughly, and I came up with some surprises. I used to play a sort of fairly risky sharp style of chess, which, it turned out, frightened a lot of people, because many serious chess players, many professional chess players, they don't like to be in a situation where there's any uncertainty. They like to know exactly what's going on. So I used to create very complicated positions on the board, which frightened a lot of them. And some of them were so frightened they played badly and lost. And others were so frightened that they were happy to make a draw with me. And I could see about halfway or three-quarters of the way through the tournament, I could see I was doing pretty well. And then someone mentioned to me that in a Zonal Tournament… Normally if you want to get an International Master title, you have to get a special kind of result, a very high result in three different tournaments. But somebody mentioned to me that in a Zonal Tournament, they have a special rule that if you score 66 and 2/3 percent or more, you get the IM title in one go. And so I started calculating, who do I have to draw with, and who do I have to beat to get 66 and 2/3 percent. And I managed to make it. I had enough games left that I could win against a few selected opponents who I could see weren't doing too well. And I remember in the last round I played Gligoric, a Yugoslav Grand Master who was one of the top players in the second half of the 20th Century, one of the world's top players. And I was quite fortunate that he needed it. In the last round he needed a draw to qualify to play in the Inter-zonal Stage, which I wasn't really interested in, although I could have done it if I'd beaten him, but I would never have beaten him. And I needed a draw to make my IM title, so that game lasted about ten minutes.

Newborn: So 1969, you're an international master. You're a student at St. Andrews?

Levy: No, by '69 I'd graduated university and I was working at Glasgow University in the Computer Science Department. I was a programming assistant there. I was basically teaching undergraduates how to program in Algol. I was taking practical classes twice a week, where they would come along and we'd give them a programming task. And then when they had a problem they'd come up to me, and ask me how to solve the problem. It was usually fairly simple. I remember one boy came to me once, and said, "Please, sir, my program doesn't work. The compiler says that I haven't opened the printer." So I said, "Well, I think you should open the printer, Theodore." And he went back and opened the printer, and it worked. It was very simple stuff like that.

Newborn: So now let's go back and take a look at the events surrounding your wager with McCarthy. Where did this happen, when did it happen, what was going on?

Levy: Well...

Newborn: Did you meet up with McCarthy? Tell us your recollections.

Levy: While I was at Glasgow I got interested in computer chess. I didn't actually know… I knew before I went to Glasgow that there had been a computer program in the States that took part in a small local tournament, and did very badly. I didn't know there'd been any serious research done on it. And when I was at Glasgow, there was somebody else in the computer science department who said to me that there'd been some work on computer chess, and why didn't I read this, that, and the other? So I went away and I read one or two things. And then I got rather interested in that, and started thinking about maybe doing a PhD in chess programming. And the leading expert in artificial intelligence was Donald Michie, who ran a department at Edinburgh University called the Department of Machine Intelligence and Perception. And Donald turned out to be a really major influence in my life, because I was introduced to him... I went to visit him in Edinburgh, it was only 14 miles away. We became quite friendly. He was very kind to me, and he invited me to attend a workshop he ran every year. It was called the Machine Intelligence Workshop, and it was held normally I think in August during the summer vacation. And he had invited me to attend that in 1968, because he thought it'd be good for me to meet some of the other people in AI, and to get an idea of what was going on. And John McCarthy was one of the other people at the workshop. And one evening we were at a party, I think it was being hosted by Ann McLaren and Donald -- Ann was Donald's first wife -- and we were, I think, in Ann's apartment, and I was sitting next to John on the sofa and we were chatting, and John suddenly said to me, "Would you like to play chess?" And I said, "Fine." So he produces this chess set.

Newborn: He knew you were the Scottish Chess Champion?

Levy: He knew I played chess. I don't know if he knew I was the Scottish Champion, and I hadn't told him, but he may have been told, I don't know. So we played chess, and I mean, John is not a tournament player, but for a non-tournament player, he plays a fairly good game of chess. And so the game went on for a while, and I beat him. And at the end, he said, "Well, David, you might be able to beat me, but within ten years, I'm sure there'll be a computer program that can beat you." And I thought this was utter nonsense. I mean, I'd recently played… a few weeks earlier, I'd played against the Alan Kotok program that was written in the early '60s. It was being exhibited at an IFIP conference in Edinburgh in 1968, and I'd gone along, and I'd played a game against it, and I'd watched it play. And I sort of dusted it off fairly easily. And when John said that within ten years I'd be beaten by a program, I thought this is just optimism. I said to myself, "This is the world's leading expert in AI, and he obviously is very enamored of his science, and he has great confidence in his science, but he's being unrealistic. He just doesn't realize how difficult it is to play chess, and how much there is in chess." So started saying things like, "Oh, you can't possibly be serious, John. This is absolutely far from what's going to happen." And he was really firm on it. And I've always… even before then, I've always been a bit brash about making bets, quite often for significant sums. And I used to play poker a lot at university, so I've always been a bit of a bettor. I wouldn't say a gambler, because I normally only bet when I think I'm going to win. So I said to him, "Would you like to make a bet on it?" And he said, "How much?" Now at that time, I was...

Newborn: Were there other people around listening? Or were you off by yourselves?

Levy: No, there was nobody.. I don't think anybody was listening, but there were a lot of people close to us. I mean, the room wasn't huge. But at that point in the conversation, it was just John and me.

Newborn: And no alcohol was being consumed?

Levy: Oh, there was alcohol all over the place! Yes, I mean, this was one of Donald's parties. His parties were very good. Alcohol and food. So I thought for a moment about how much to bet, and at the time I was earning the princely sum of 895 pounds a year, which was, like, less than $2,000 a year. So I said to John, "500 pounds," which represented at that time more than half a year's salary. I was absolutely certain I was winning. It was a figure I plucked out of the air. I didn't really expect him to take me seriously and to accept. And John's reaction was immediate. He called over to Donald. Donald was sitting on the floor about, I don't know, about ten feet away from us, I suppose. He called over to Donald, and said, "Donald, listen to this. David wants to bet me 500 pounds that within ten years there will not be a program that can beat him at chess. And Donald said, "Can I have half the bet?" <laughs> So that gave John fire and enthusiasm to accept me. So they accepted. So that's how it started with 500 pounds.

Newborn: So initially there were the two of them that were going to split 500 pounds?

Levy: Yeah.

Newborn: And this was decided at that evening.

Levy: It was decided on the spot. We shook hands and we agreed that by the end of August, 1978, if I hadn't been defeated, I would collect my money.

Newborn: Were there others that wanted in a little bit later then?

Levy: That's right. I also went along to the following year's -- I think it was the following year -- another of Donald's Machine Intelligence Workshops. And one of the lecturers there was Seymour Papert. I think there was a talk by someone on the chess, I think there was somebody called John Scott gave a talk on chess, and so we came around to the subject of when computers will start playing master level chess. And Papert was even more dismissive than Donald and John. So I said to Papert, "Would you like to take part in my bet?" And he didn't know about the bet. So he asked me about it, and I told him. He said, "Oh, I wouldn't bet you for ten years, I'd bet you for five years." I said, "Well, I couldn't do that, Seymour, because that would be unfair on you." I said, "But if you'd like to come in on the bet for ten years, I'd be happy to take you on for another 250 pounds." He agreed immediately. So that was three of them. And then I think it was a year or two later, in 1971, I was invited for the first time by Hugh Montian and Ben Mittman to come along as MC for the ACM Annual Computer Chess Championships. And at one of those events I was talking to the programmers of the COKO program, and Dennis Cooper, and Ed Kozdrowicki. And Kozdrowicki was sure I was going to lose. So I invited him to join the club, as it were. And so Kozdrowicki came in for 250 pounds. For a while, the bet stood at 1,000 pounds. And I was still utterly confident I was gonna win. Then much to my delight, some time around 1974 I think it was, Donald Michie called me up and said he would like to know whether I would be willing to increase his share of the bet from 250 to 500, which would bring it to a total of 1,250 pounds. And of course, I was still supremely confident, so I took him on. And that's how the bet ended.

Newborn: What do you think motivated his interest in increasing his wager?

Levy: Well, part of the wager that he wanted to make, which I also took on, was a side bet that if I lost the bet, it would be to a program that he developed, or that he helped develop. His thinking was that he himself was going to get involved in chess programming, either on the dirty end of it, or leading a team, taking charge of a team. And he was very, very confident. He obviously had some ideas that he thought he was going to be able to instill in a program and beat me.

Newborn: Was there a written document on this? Was McCarthy aware of these other people were getting involved?

Levy: I don't think… There was never a written document. And I'm not sure how aware John was. He certainly knew about Seymour Papert because I visited John in the summer of 1971. I stayed at his house one night, slept on a waterbed for the only time in my life, which is a very strange experience. We discussed the bet then a little bit, not very much. So John certainly knew that Seymour was involved. I can't remember exactly when Kozdrowicki came in, but I wrote about the bet quite a lot, and it was being publicized quite a lot. So Kozdrowicki's name was mentioned.

Newborn: So the wager is made, and you're a British International Master, and you're now involved in helping to organize and direct some of the major computer chess events. And watching the programs get better. During this next ten years, there's a number of things that happen, sort of like stepping stones on the way as far as the programs go. You had a simultaneous match at one point with a bunch of computers. You had a match with Slate, and Chess 4.7 as a team. You had a match with Kaissa leading up to this match. Was it with Kaissa?

Levy: No, I think it was with the Northwestern program. And it was played… I had two encounters. One was a two-game match played at Carnegie Mellon, and I won. In fact, I won the first game, so the second game was not necessary. I think that was against-- I'm pretty sure that was against Northwestern program.

Newborn: When was the Kaissa match?

Levy: I don't think I ever played a Kaissa match, but...

Newborn: You played with McGill. You came from Montreal and you played...

Levy: Did I? Okay.

Newborn: Kaissa , I believe.

Levy: I don't remember that. I remember going to MIT and playing against MacHack. And again, it was supposed to be a two-game match, but I think I won the first game, so the second game wasn't necessary.

Newborn: Did you have a few words on the Slate Chess 4.7 versus Leaky match?

Levy: Can I go back a bit in the chronology? Because one of the things that was happening in those days was these annual tournaments that you and Ben Mittman were organizing, and I was helping with and MC-ing. The first one of those, as I said, that I did, you started it in 1970. You organized the first one in New York in 1970. I came in at the second one in Chicago in 1971. And one of the things that was very noticeable to me very quickly was the friendly atmosphere at the tournaments, in which the programmers would chat to each other while the games were in progress and between rounds. And they would get ideas from each other. So that after each tournament, the programmers would go away not only with more knowledge about their own programs, but with knowledge about how other people were doing things. And this, in my view, was the main factor in increasing the strength of programs steadily year on year. It was just an acquisition of important knowledge by most of the people in the field. So I think the importance of these tournaments cannot be underestimated in the whole history of the progress of computer chess. At the time, your tournament, the ACM Tournament which you were organizing was the only one in the world. But I remember very well in 1973 when we had the ACM Tournament in Atlanta, and after the tournament was over, you and Ben Mittman and I were in the bar at the Hyatt Regency, and Ben said, “Gee, guys, this is such great fun. What can we do next?” And I thought for a moment, and I said, “Why don’t we have a world championship?” And so we started talking about it, and then I explained to the two of you that how FIDE organizes its world championship every three years, which it did at that time. And we all agreed that would be a lot of fun. And so we started thinking about where we could hold it, and who would sponsor it. I can’t remember whether it was you or Ben mentioned that the following year there was going to be an IFIP Congress in Sweden, in Stockholm. And so somehow contact was made with IFIP, and they liked the idea. So they put up the money for sponsoring the championships in Stockholm, and we all went off to Stockholm. That was very interesting, because we not only had most of the top programs from the ACM Tournament, we also had some European programs who were able to get there more easily. One of those was Kaissa, the Russian program, about which we knew nothing before it entered for Stockholm. I remember there was some concern, I think it was expressed initially by Hans Berliner, but there was some concern that how do we know that the Kaissa people are going to play fair? Because you know, they’re running by telephone to Moscow. How do we know they haven’t got a grand master in the room? I was the tournament director, I think. I arranged for an employee of ICL, which was the British company that made the computer that they were running on, and I arranged for one of their employees, a Brit, to be in the computer room when the games were being played, just to oversee it. So we all showed up in Stockholm, and that was the first world championship which Kaissa won. I think from then on we held world computer chess championships. Initially, we held them every three years, just like FIDE does, and then we changed to make them every year, because progress was getting quite serious.

Newborn: Let me come back to your match with Slate and Chess 4.7. I think that was 1978 or ’79 you played that match.

Levy: It was ’78. It was at the end of the ten-year bet period.

Newborn: Did you _____?

Levy: No, the match was played at the Canadian National Exhibition in Toronto.

Newborn: Oh, that match. No, I’m thinking of the match that you played-- there was a match between Slate and Chess 4.7, where they sat down as a team.

Levy: That’s right. I think you’re right. I believe that was-- I’m pretty sure that was in Detroit. That was in the Renaissance Hotel in Detroit, if I remember correctly.

Newborn: I’m just interested in what you thought about its playing strength at that point. And your match is still a couple years away, I believe. No, your match is coming up fairly soon.

Levy: It was coming up -- I’m not even sure that that was before my match. Well, was that before my match or after?

Newborn: Well, I believe it was before.

Levy: Which year was Detroit? It was ’78, wasn’t it?

Newborn: This is getting lost in the noise. Well, let’s go on to...

Levy: Well, we’ll have to edit that bit out. But I can talk about that game a little bit. Only a little bit. The game against Slate playing in combination with a program, that was the first example of what is now called advanced chess. And it was interesting because it was an innovation at the time to have a chess master playing against a program together with a human chess player. The idea was that both the program and Slate were weaker than me, but the idea was to see whether together they could make a formidable pair. I don’t remember the game itself, but I remember that it was quite easy for me to win. But what’s interesting is that about 20 years after that, Kasparov came out with the idea of, as it’s now called, advanced chess, with a strong grand master plus a chess program, against another strong grand master with a chess program.

Newborn: If two people play together of equal strength, let's say, two players of 2200 or 2300 level strength, how much better do you think their rating would be as a team?

Levy: It's difficult to quantify, but it would be measurable, and it would be significant. It might be 100 points, I don't know. It's very clear that a top grand master plus a program is a much more powerful combination than just a program by itself, or just a grand master by himself.

Newborn: But it wouldn't be 200 points?

Levy: I doubt it. I mean, 200 points at that level is a lot. It could be, but I doubt it. I don't think there's been any sort of scientific study of what the actual difference in performance is.

Newborn: Your judgment would be fairly good that it's probably 100. Clearly less than 200.

Levy: I would say so, yes.

Newborn: All right. Let's go on to your match. You finally have a match with Chess 4.7 at the Canadian National Exhibition. Tell us about it, and then I'll ask you a few specific questions.

Levy: Well, as the time got near for the match to be played, I'd already been doing quite a lot of work in the field of computer chess, work of various sorts. I was beginning to realize that computer chess was becoming a very, very important part of my life. I was getting interested in using it as a revenue stream, because I was spending so much time on it. So I managed to get some funding from the Canadian National Exhibition to promote the match, and I got a fee, and Slate and Atkin got a fee. The match was played in a soundproof glass booth at the Canadian national Exhibition, which is a big exhibition held every year in Toronto. And I had to wear a tuxedo, which is not normal for me. In the 19th Century, grand masters used to wear tuxedos when they played important tournaments, and the early part of the 20th Century, so it was sort of nice. And I was playing against the Slate and Atkin program, Chess 4.7, running on a CDC Cyber computer, a very powerful computer located in Minneapolis. When I turned up to play the first game, and sat down, I was expecting David Slate or Larry Atkin to be sitting opposite me making the moves. Instead of which, they wheeled in this really attractive young lady. They clearly decided that they were going to distract me. And she sat there smiling at me the whole time. It was really quite difficult. I had to sort of do what I do in human tournaments, and put my hands like this and look down at the board when I was thinking. And then between moves when I was relaxing, I was sitting there, and she just sat there smiling at me. It wasn't the easiest circumstance under which to play. But I worked out my strategy beforehand, and I developed this sort of anti-computer strategy. And in those days the strategy was very successful, because programs could see a certain distance ahead, but they

couldn't see very far ahead. So what you had to be careful of is, you had to be careful of very short-term tactical tricks. You had to just check that there wasn't some sequence of three or five, or maybe even seven moves, that the program could win material, or do something really unpleasant to you. And once you got past that, if you could accomplish that safely, then you just have to develop a long-term strategy for the game. And so I developed a very, very sort of super long-term strategy. I made moves that appeared to have no point at the time, but they were moves which I knew if the game developed as I expected it would, would have a point much later on. But so far into the future that the program couldn't understand it. And the result of that was that the program basically had no idea what was going on. It was just playing the current position with no regard for long-term strategy. Every now and again, it would make a move that created a slight weakness in its position, or move the piece from one part of the board away to where it wasn't defending some area that I wanted to go into much later. And so gradually this strategy led in the first couple of… Well, the first game was almost a disaster. Because I did it too much, and I was in serious trouble, and I very nearly lost the first game. But I managed to draw. It was the first game that I managed to draw. But pretty soon in the match, my strategy worked, and I was winning game after game very comfortably. I remember in particular one of the games where I played an English opening, but I played it as though I was playing a Sicilian defense but with white. The Sicilian defense is a chess opening which is my lifetime favorite, but I was playing it with an extra move. I adopted the strategy of the Sicilian defense, but with white. I knew exactly what the long-term strategy was. The long-term strategy in the Sicilian is that you play to reach an end-game. An end-game with a particular kind of formation, which if you can get there in the Sicilian defense, you stand pretty well. So with the extra move, you would stand even better. That was my long-term goal, and I pushed the program off the board. It was a six-game match, and I think after three games, I had a score of two-and-a-half out of three, so I was feeling pretty confident. And then I decided to take a chance. I'd been very successful with my strategy. I felt very confident that I could use that strategy probably to win every game in the rest of the match if I needed to. So I decided to take the chance and see what would happen if I played very sharp tactical chess. I played a really unsound opening, and the position got very sharp, and the program just killed me. So after that game I was still leading two-and-a-half to one-and-a-half. So we played four of the games, and there were two more games to come. So then I said, "Okay, David, this is time to take it seriously." So I sort of buckled down, and in the fifth game I pushed it off the board again with my long-term strategy and the match was over, because I'd scored three-and-a-half points.

Newborn: So did you play that final game?

Levy: No, the final game wasn't played.

Newborn: So you won three-and-a-half to one-and-a-half.

Levy: Yeah.

Newborn: So when you came out of it, what was your rating at that time, and what rating would you assign to the computer?

Levy: The international rating scale and the US Chess Federation rating scale are different by about 150 points. On the international scale at that time, I was about 2,360 to 2,370, something like that. So on the US Chess Federation scale, I would've been about 2,510 maybe. How strong was the program? It was a lot weaker than me. I would say it was at least 200 points weaker than me. It was good enough that if I'd made a stupid mistake it would've beaten me. Or playing a very risky strategy, as I did in game four, it could beat me. But as long as I was careful, it had no chance.

Newborn: So the point is: was the score of three-and-a-half to one-and-a-half consistent, forgetting how the match was played? If somebody told you that they had played a match with somebody with a three-and-a-half, and one-and-a-half score, what would you assume that the rating difference would have been?

Levy: Without looking up the...

Newborn: Nothing more than...

Levy: You can determine the rating difference from score. But without looking up the rating table.. I don't keep those statistics in my head.

Newborn: Just guess to some degree.

Levy: Maybe a couple hundred points. I don't know, you could look it up on the Internet.

Newborn: It was about 150 to 200 rating points weaker than yourself at that point.

Levy: I think it was more. Because if I'd wanted to win the match by a bigger score, I think I could probably have won by three-and-a-half to a half, just by not taking any risks in the fourth game.

Newborn: So was it approximately 2000, maybe more, questionable.

Levy: Yeah.

Newborn: So now the wager continues. This match finishes, and somehow the world wasn't quite ready to throw in the towel, and you weren't ready to throw in the towel. So the wager continued. How did it wind up continuing, and let's go on with this story.

Levy: Well, first of all, I should mention that when I won the match, I got a very nice letter from John McCarthy when he sent me his check. And John said he didn't mind losing the bet, because when he made the bet in the first place, he was expecting me to lose to an intelligent program, and he was very sorry to see that all the real progress that had been made in computer chess was made by programs using the so-called brute force approach, where they're not intelligent. They think in a fairly dumb way, but they look at so many positions and look so deeply that they come up with good chess moves. Because the strongest programs of the day were not playing in the way that John expected them to and wanted them to, he didn't feel any sadness at losing the bet. So that was pretty nice. Donald Mickey was also very friendly and magnanimous, and Seymour Papert, too. The only fly in the ointment was Ed Kozdrowicki who welched on the bet. So only collected from three of them. But what happened after that was that I was talking to Dan McCracken, who was one of the leading computer science experts in the world at that time, I guess, and he'd written lots of books on FORTRAN and he was very well-known. I think I met him at one of the ACM Tournaments. And I mentioned my bet, and he said to me something like, "Well, you wouldn't make another bet now, would you?" And I said, "Why not? I think I'm good for another five years." So Dan and I made $1000 bet for five years. I think we started that early in 1979. Sometime in 1979 anyway; I think it was fairly early, I'm not sure. And that was for $1000. And at the end of the five-year period, I played a match against the World Computer Chess Champion program as it was then, Cray Blitz. It had won the world championship in New York in 1983. I beat Cray Blitz very easily. I think I won four-nil, but one of those may have been a forfeit because they had a hardware problem. But I never had any problem. I trained for that match very seriously. I had my friend Danny Kopec, who's also an international master. He worked with me for a bit, and we sort of developed the "do-nothing" strategy, as I called it. We developed that a bit further. Although I'd retired from competitive chess against humans in 1978, Danny sort of brought me back to speed a bit. We played a lot of fast games together to hone up my tactical ability, which had sort of got a bit rusty. I was in pretty good shape for that match and the program never stood a chance. So I won that bet as well. Then I thought, "Well, there're all these programs out there, and they've all been striving for years to beat David Levy, and it's sort of unfair to take the target away. On the other hand, I didn't want to make any more bets, because I could see by 1984, I could see the writing was beginning to come. Ken Thompson was doing well with Belle, and I could see that things were showing signs of some serious progress. Although I didn't think I would lose for a while, I thought I would really like to leave myself as a target. So I think spoke to-- I remember what happened. I was interviewed before and after my 1978 match. I was interviewed by a guy called Christopher Evans, who was working on a series of TV programs on computers and AI. And he also was a consulting editor for *Omni Magazine* in its heyday. So I got in touch with *Omni Magazine*, and I said, "Look, this bet of mine has got a lot of publicity. I would like to set up a challenge now. I'd like to offer $1,000 to the first programmer or programming team that wins a match against me. And I'd like you to add another $4,000, so we have a $5,000 prize." And they agreed. So this prize became a sort of milestone that would last as long as I lived. There were no real serious takers until the Chip Test people

came in. I mean, that program was originally called Chip Test, and then it was called Deep Thought. And it was when their programs started getting stronger that I knew my number was up. One day I got the inevitable phone call from Donald Michie, who decided he wanted to arrange a match in London with me playing against Deep Thought. And that was played, I think, in 1991, late. No, it was played in '89, that's right. It was played at the end of '89. We played that at the headquarters of the British Computer Society. Again, Danny came over and helped me prepare. But by then the program was significantly stronger than me. Very significantly stronger than me. And even stronger than I had been at my very best. And I was a bit rustier. Although I managed to get a very good position in the first game, I lost all four games. It just destroyed me. I had not chance.

Newborn: So when you went into that match, did you think you had some chance, or did you think it was pretty bleak?

Levy: I knew it was pretty bleak. I actually predicted in advance I would lose 4-0.

Newborn: And that's what it was.

Levy: Yeah, it just killed me. On every game I had no real chance. Even if I had a good position, I had no real chance. The program could just see too much.

Newborn: So from '68 to '89 you were the boss, and after '89 you had to accept your fate.

Levy: That's right. And you know, I was quite happy. I'd had a good run for my money, 21 years against an original bet of ten years. I think I sort of held up the human end of the man-versus-machine struggling chess pretty well. I got a lot of publicity. It was good for my career. It was very good for my career. That's one of the reasons why I think that Donald Michie was such a big influence on my life. It was because he was so enthusiastic about taking half of the bet that the bet really materialized and enabled me to achieve quite a lot in the field of computer chess.

Newborn: Your involvement with chess and computers hardly ended at that point. Brings me to my next general topic. It was a few years later that we were involved in bringing Kasparov to the chess table for his first match with Deep Blue, and you played a key role in working with Kasparov and his agent. Can we talk about that a bit?

Levy: Can I just go back in time a bit? Because there's one other thing that's probably interesting to mention. After I'd been involved in the computer chess world for a few years, I think it was during some time late 1976, or possibly early '77, one of the interviews I did, the interviewer asked the question, "What

would you like to do in computer chess? You know, you've been involved in these tournaments. What else would you like to do?" And I said, "What I would really like to do is to have a big company like Texas Instruments or Hewlett-Packard hire me to advise them on how to write a chess program." And this got published. And when I was at the-- I think it was maybe the ACM Tournament in Columbus. Was it in Columbus, Ohio? I remember when it was. It was when I was at the World Computer Championship in Toronto in 1977. During the course of the tournament, I got a call from a guy at Texas Instruments. He said, "Hi, my name is Michael Hagen. I've just read this interview you gave saying you'd like a company like Texas Instruments to hire you to help them develop a chess program. I said, "Yes, that's right." And he said, "Are you serious?" I said, "Yes, I'm very serious." He said, "Can I come and see you?" So I said, "Sure!" So he flew up to Toronto, and I was there with my wife, and he said, "Look, we're interested in computer chess. Would you and your wife like to be our guests in Texas? Would you like to come down and talk to us? You'll have to sign a non-disclosure agreement, but there's something we'd like to talk to you about. We'll cover all your expenses. And then it might be interesting for you." So I said, "Sure." We were actually on vacation in North America after the Toronto event, and so we flew down to Texas, and I went to Dallas. I met some people in Dallas, and they said, "We are developing a chess program. We want to develop a chess program. We have a product coming out." They wouldn't tell me what it was. "We have a product coming out for which a chess program would be useful. We'd like you to help us." So we negotiated a deal, and I think what happened was-- oh, that's right... Then they asked me to go to Lubbock. So I went from Dallas to Lubbock, again, I was with my wife. And in Lubbock we met an Englishman who was running TI Lubbock, and he negotiated the fee with me. We discussed how it would work, and that I would have to go out there several times. I would write a specification, I'd have to go out there several times to liaise with the team. We decided that was fine so I carried on on my vacation. I remember sometime later, a month or so later, I was in Seattle. I think that was at the ACM in Seattle maybe. Anyway, I was in Seattle and I got a call saying, "Okay, we have a contract ready for you to sign." They flew somebody from Texas to Oregon, where I was going to be driving through, and I met this guy at an airport, and he got off a plane from Texas with a contract, and I signed the contract, and he got back on the plane and went back to Texas. I thought this was all great fun. Anyway, as a result of that, I commuted to Lubbock, Texas 11 times over a period of 18 months between the end of '77 and the middle of '79. We developed a chess program for the TI 99/4 home computer. I believe it was the best-selling program for that product. That really got me interested in the commercial side of computer chess, in creating programs. Immediately after that in using the money that I got from that job, and from that consultancy, I set up a small software business in London to develop chess programs. Since then I've developed maybe 100 programs for maybe 100 chess computers manufactured in the Far East and sold all over the world.

Newborn: Your program Philidor was one that actually competed and had reasonable success for a number of years.

Levy: Yes, I think the first time I competed was in one of the ACM Tournaments, and this was a Z-80 program running on an Osborne computer, which was, I think, one of the first Z-80 computers one would

buy in the UK. I remember one game that gave me huge pleasure was at one of the ACM Tournaments. One of our colleagues Tony Marsland, who had a program that ran on an Amdahl machine that cost about $10 million. Tony had always been saying that it wasn't fair for some people to have Amdahls and some people to have very small feeble computers. He was in favor of handicapping the programs in some way. Of course, we never did that, but it gave me great pleasure that my program beat his program, and he was running on an Amdahl, and we were running on a Z-80.

Newborn: Let's slide over to 1994, 1995, 1996. You've been a major figure in the organization of the chess events in England up to this point. You're familiar with Kasparov's agent. We're friends. We've talked on the phone about possibly arranging a match through the ACM with Kasparov. And you say, "I'll do what I can to help." Tell me what you did and let's see where we go from there.

Levy: Okay. Well, I first met Gary Kasparov in 1985. The circumstances were that there was a lot of dissatisfaction in the chess world, in the human chess world with FIDE, the World Chess Federation, because the president of the Federation was a Filipino called Florencio Campomanes. He ran FIDE in the way that his friend President Marcos had run the Philippines, as a kind of dictator, and he'd caused a lot of dissent. There was a lot of unhappiness with him. In FIDE we wanted to get rid of Campomanes and replace him, and Gary was very much in favor of this. The first meeting I had with Gary on this subject was at Amsterdam airport in 1985 when we discussed the campaign, a sort of political campaign in the World Chess Federation to get rid of Campomanes. It wasn't successful because Campomanes knew who to bribe to get the votes, and in the end we were unsuccessful. But that was how I met Kasparov for the first time, and we always got on pretty well. Then the following year, he came to London for the first half of his world title defense against Kasparov. That match was organized half in London and half in Leningrad. I was one of the organizing team with the London end, so again, I got to see him quite a bit. So we got to know each other. We met each other several times over the next few years at various chess events. Then I got this call from Hugh Monty saying that there was some interest by IBM in playing a match between their chess program and Kasparov. I think I got the call some time early or spring of 1985. I knew Gary, and I also knew Gary's agent, who at that time was Andrew Page who lived in London. I called Andrew and we discussed what sort of money would be needed, and what the conditions should be. We had some back-and-forth, and Andrew -- in those days we didn't use email, we used fax. I'm not sure if we were still using Telex then. I don't think so. Anyway, Andrew got in touch with Gary, and I sent some suggestions, and they went back and forth from me to Andrew, from Andrew to Moscow, back to Andrew, back to me. Pretty soon we had an agreement. I mean, it was pretty easy, because Gary was quite enthusiastic about chess computers, about computer chess in general. He could see a great potential for human chess players in having computers take part in human events, and having contests between humans and computers. He was really interested. He was fascinated by the field. He thought it was of great interest scientifically, and from the chess theory point of view. So he was always very pro-computer chess. In fact, shortly before I lost my match against Deep Thought, Gary played a two-game match against Deep Thought in New York, and he won very comfortably, of course. He simply created positions where the program didn't understand what was going on. He just blew it off

the board. So he was already familiar with the program. Of course, he was extremely confident, and he was quite keen to play, and there was a nice pot of money for him for doing so. So pretty soon we had an agreement. I drafted a contract, Andrew sent it to Gary, we had discussion on one or two points. It was a very short contract, I think, only three or four pages, maybe even less. Pretty soon we got to the point where the contract was signed. Andrew got Gary's signature on the contract, and gave it to me. I took it to Hong Kong where we were holding the 1995 World Computer Chess Championship. At that tournament, the IBM program was taking part, and so CJ Tan of IBM, your friend, who happened to be in charge of the Deep Thought, or Deep Blue, team as it became, he was there with the team, and we signed the contract. It was really a four-way contract. It was signed between Gary and IBM, but the two other parties were the ICCA, as it then was, the International Computer Chess Association, and the ACM, which was the Association for Computing Machinery, which was sort of the hosting organization. We signed the final end of the contract there. I still have the contract at home, the original. That was for the first match that took place in Philadelphia in February, 1996.

Newborn: When the negotiations were going on, did Kasparov look at this as a financial donation, or did he look at it as a serious match?

Levy: I think that he looked at it as something that he would certainly win, but which would be interesting. I think he regarded it as interesting. He knew how the program was already playing -- grand master level chess -- because we'd seen even before it beat me, I think, or around the time it beat me, the program played in some tournaments with some very strong grand masters. It won a tournament in Long Beach, California ahead of some strong grand masters including the former world champion, Mikhail Tal, and during that tournament it actually destroyed Bent Larson, a very, very strong grand master and world championship candidate. Destroyed Bent and their individual game. So it was clear the program…. Gary knew the program was strong. He just felt that he was very confident he could beat it. That although it was a grand master strength, there were grand masters and grand masters, just as there are in every sport. So I think, yes, he regarded it as a financial-- not a donation, because for him it's work, it's time. He had to go into a bit of training for it. But like any professional at the top of their field, he expects to be financially rewarded for his time and his efforts.

Newborn: The purse was divided. The half million dollar purse was divided four to one. Four hundred to the winner, one hundred to the loser. It's my recollection that his initial request was that it be all or nothing.

Levy: I can't recall what the final figure was. I've got it in the contract at home. I can't recall whether he actually asked for it to be all or nothing. I simply can't remember, I'm afraid.

Newborn: Now the match itself, 1996. It's in Philadelphia. What are your recollections?

Levy: Well, we turned up in Philadelphia. The playing conditions were extremely good. The room that Gary was playing in was a spacious room. The public was seated a couple of rooms away in a very large hall where they could listen to expert commentary so they understood what was going on in the game. But Gary's playing room was very comfortable, and he had his own sort of resting area nearby. Because by that time, I'd been involved in helping to organize two human world championship matches, the first half of the match in '86, and then the whole of the 1993 world championship match, which was played in London, I knew what was needed for a world chess championship type event. I told the local organizers in Philadelphia what they needed to produce, that they needed to have a rest area where Gary could go and relax when the program was thinking. He could go into a room, sit down in a comfortable chair, have a refrigerator, some food and drink there, a restroom. And it was very comfortable. I think the lighting was excellent. All the conditions were ideal.

Newborn: Now the final score was four to two. In the fifth game there was a draw offered by Kasparov in the second final. In the fifth game of that match, Kasparov offered a draw late in the game. I'm not sure if you recall that.

Levy: No.

Newborn: Point was, that that would've evened the score going into the final game.

Levy: I can't remember that.

Newborn: You don't remember.

Levy: No.

Newborn: Now coming out of that, the score was four to two. What would you say if Kasparov played somebody and had four-two score, what ratings would you assign to those players approximately. Again you can't be too precise, but...

Levy: Well, again, I could tell you in a second if I could look up the rating table on the Internet.

Newborn: You've had years of experience with these things. What would you guess? 200 points, 100 points?

Levy: Maybe 150. I'm not sure. I'd just be guessing. I mean, you know, you can probably look it up while we're here in the break between shots. If I can have access the Internet I can tell you immediately.

Newborn: Just interested in your perspective of the difference in their abilities at that time.

Levy: Well, the difference in abilities is not always reflected in the difference in the ratings. Sometimes players play above or below the level you expect when you look at their ratings. I would say that at that time the program was at least 150 points weaker than Kasparov. It was strong enough to make him think. The program won the first game, of course, which really surprised him, shocked him. So it was clearly playing good grand master level chess. So I think maybe something between 150 and 200 points below him was the level it was playing at was my guess.

<tape break>

Levy: -- world, I knew some of the Grandmasters who were - went to visit IBM. I was told that they were getting a lot more chess knowledge into the program. But I suppose it was because I was conditioned, really, over many years of people predicting progress faster than it came. I just didn't think they could make the necessary leap forward in the space of a year and a quarter.

Newborn: The year before you said they were rated 150 points weaker. Now, the best player doesn't always win a match, so do you have any perspective of their rating coming out of that '97 match?

Levy: Well, if you beat a player rated over 2800, then your rating should be over 2800; I mean, that's the level at which you perform. It doesn't mean that your rating over all of your games will be 2800 or more; it means that you have actually performed at a level over 2800. Now, what's interesting -- what's personally interesting for me about what happened in '97 is that a few years earlier, I think sometime around 1986, when I took over as President of the International Computer Chess Association, I wrote an article in which I tried to predict what was going to happen in the man-versus-machine struggle. What I did was, I looked at all the major performances by programs, in events against humans over the years. I plotted the rating against the year. So whenever, for example, a program took part in a tournament with strong humans, it would get what we call a performance rating, that's how well it performed in that tournament. I plotted those rating points -- I wrote this article for the ICCA journal -- I plotted those rating points against time, and I did a best-fit straight line. So I sort of had a straight line that predicted where things were going to go. The year in which my line predicted a program would first win a match against the world champion was 1997. So when it happened, although I felt very sad for -- I felt very sad really. I felt sad for Gary, and I felt sad that the match had ended the way it had, with the last game being a complete debacle rather than a proper struggle. But I was very pleased that my prediction, which had been made several years earlier, turned out to be spot on.

Newborn: So the best player doesn't always win. One would argue that Deep Blue wasn't as good a player as Kasparov, but it did win the match, nevertheless.

Levy: Yes, I would agree with that. I think at that time, Deep Blue was not as strong as Kasparov. He certainly knew much more about chess than the program did; there's no doubt of that. But I think even the program playing at its best, I still think he would have been stronger, but not by much. I think the way the program played in the second game, which was the crucial game of the match, the way the program played in that game shows that the IBM team had done a really good job of preparation. They'd focused a lot on that particular opening, the Ruy Lopez opening. They'd given the program a huge amount of knowledge, so much so that Kasparov found it almost unbelievable that the program could play well in positions of that type. Because it was not the sort of cut-and-thrust type position that programs always excel at. It was the type of position that requires long-range strategic planning, the sort of position the programs could never play in the days when I was playing against them. But even in 1997, I think the top Grandmasters and a lot of computer chess experts didn't believe that a program could play strategic chess that well. Gary certainly didn't believe it, and he was really incredulous that here was he facing a program that was playing, if you like, like Karpov, or Spassky, with the same knowledge and understanding and judgment about how to handle the white side of a Ruy Lopez. And to him that was just unbelievable.

Newborn: Going into that second round - Kasparov had won the game in the first round - he had won the last two games in the previous match. So here he is, he's won three games in a row against the computer; he must have been very much confident that he had everything under control.

Levy: Yes, I would think so.

Newborn: And all of a sudden, he's in a game that he resigns in an evidently drawn decision. Why would he have resigned? He had to be fairly confident at that point that he had everything under control, and here's one game he's not doing so well. Why would he have turned from so confident to so unconfident, in some sense?

Levy: Well, there are a couple of thing about that game that are really important, in addition to the fact that the program played like a strategic genius. It played like an absolute strategic genius. There had never previously been a game - and I don't even think there's been a game since - that a program has played with that level of strategic understanding from beginning to end. It was almost entirely a strategic game. What happened in the game is that Kasparov was steadily outplayed, and his position got worse and worse, very slowly, but very steadily. And he could see it happening. He was obviously sitting there realizing that he was now up against an opponent that was playing strategic chess as well - just about as well as it can possibly be played. Then he gets to this position - in those days the games were adjourned if they weren't finished after five hours or four hours - he gets to a position where there is one move that

looks as though it could possibly let him off the hook. This was a move of his queen to E3. It looks as though it was possible that this move might force a draw, by what we call perpetual check. You just check the other guy backwards and forwards, and he can't get out of it, so it turns out to be a draw. Kasparov said to himself the following; he said, Well, Queen E3 cannot possibly draw, because if it could draw, the program would see that it draws and wouldn't have allowed me to play it, so it can't draw. So he resigned. I can't remember whether he resigned or played a different move. I think he actually resigned at that point. It was only later that it was discovered that Queen E3 in fact was a draw. Now, what I've been told, and Murray can verify this, is the following: that there was a bug in the program, a very obscure bug, that manifests itself very, very rarely, and when it does manifest itself, the program plays an almost random move. And it just happened, purely by chance, that that bug surfaced on the move before, the move that allowed Gary to play Queen E3. And because of that, the program did not play the best move. Had it done so, the program would still have had a winning position. But because this bug surfaced - and from what I've been told, it was only expected to appear once in a blue moon - it let Gary off the hook for one move. But he was so impressed with the way the program had played, he didn't believe that Queen E3 could possibly be a draw. It would be like his program having a mental aberration, which in fact is what happened, and he didn't believe it. So he thought the position was lost.

Newborn: He also thought that there was some funny things going on beyond what the computer was doing.

Levy: That's right. He was so amazed at the skill, the strategic skill being exhibited at the chessboard, and having, as you said, won the three previous games against the program, and he was of course familiar with the program's style of play, with its strengths and its weaknesses, he just couldn't believe that this was Deep Blue acting alone. He felt that there as some outside influence. What he suspected was that over the road in the - I think it's the Leonardo Hotel, was it? - the hotel over the road from the building where they were playing the match - he suspected that there was one or more Grandmasters sitting there, looking at what the computer was thinking of doing, and maybe occasionally giving it a nudge if it was thinking of doing not the best move. That was his feeling. He wasn't sure what was happening, but that was the kind of thing he was thinking of. That made him really upset, and very angry, and of course, he wanted to find out more, and he was trying to insist that IBM divulge the logs of the games then and there, so that he or an expert nominated by him could look at them and see if anything was going off. Of course, IBM was under no obligation to do so, because they hadn't signed a condition like that in the contract; it hadn't been specified in the contract. And so they refused and that made Gary even more upset.

Newborn: So he draws the next three games, and these were hard-fought games, if I remember.

Levy: Yes, they were all hard-fought games. I think he was pushing quite a lot in those games, but each time the program was extremely resourceful; it played very well. It was playing not quite at his level in

those games, but very close. It was playing a little below his level, allowing him to get some chances, but it was playing well enough that it could hold those games.

Newborn: And so the final game comes along, and he plays a very strange opening. To what extent do you think he… When did he plot that opening? Did he prepare that opening in the weeks before, in the days before, in the hours before? What do you think? Or do you have no idea?

Levy: I don't know when he made the decision to play the Caro-Kann defense in game six. What I remember about game six is that shortly before the game started, I was in the press room, and Malcolm Payne, who's another International Master, a friend of mine from England, came up in the lift, and he was looking quite shocked. I said to him, "What's up, Malcolm?" He said, "I've just seen Gary, he looks absolutely dreadful." He said, "Today is going to be a complete disaster." Sure enough, the game started with the Caro-Kann defense. Now, the variation that Gary chose is a very well-known variation. In a particular position, in the very early stage of the game, around move six or seven, there are two moves played by Black. It's very important to play them in a particular order. If you play them in the right order, Black has a perfectly playable position and it's the kind of position you want to get if you're Kasparov against the computer, because it's slightly unbalanced, and you've got chances to play for a win without risking too much. And the Caro-Kann defense has been used by various world champions. It was used by Botvinnik; it was used by Petrosian; it was used sometimes by Karpov. And so it was a sensible choice to play the Caro-Kann, but Gary's frame of mind was not what it should have been. His psyche had been shot to pieces, partly by the experience of game two; partly by the fact that he was upset by IBM's refusal to divulge the logs of the game. His morale had been destroyed. So as a result, and I'm sure this is a direct result - he played these two key moves in the wrong order. The order he chose had been played before in a few master games, not many, and it had been shown that White gets a terrific attack by sacrificing a piece, probably an overwhelming attack, but at the very least, White gets extremely good chances, and it may even be a decisive advantage. Of course, immediately the program sacrificed a piece, as we expected. I mean, we couldn't really believe what Gary had done. And he was just annihilated.

Newborn: So at what point do you think he realized he made a mistake?

Levy: Immediately. Probably immediately he touched the piece. Certainly, I think he realized it before the program's reply. The program's reply was instant. It was still in its opening book. So the piece sacrifice that it made was in its opening book. But I'm sure - at that level, you realize a mistake like that immediately. As you take your hand off the piece, you say to yourself, "Oh, my God, what have I done?"

Newborn: In game four of that match, he opened with the Caro-Kann as well. Do you think that he had planned the game six match along with the game four match? In other words, this Caro-Kann was a theme of game four and game six.

Levy: Yeah.

Newborn: Game four there was no sacrifice; the game <inaudible> a draw.

Levy: No. I think - I mean, the Caro-Kann was obviously one of the weapons he had planned to use before the match. I don't know how many variations, or different variations, of the Caro-Kann he had decided to play in the match. But clearly he was satisfied from game four. The Caro-Kann is the sort of thing you want to play when you are confident that you can hold off any pressure from White, but you still want to have a little unbalance in the position to have some chances of playing for a win. So I think overall, the Caro-Kann was a sensible decision. The problem was that because his whole psychological state had been destroyed, he just played the moves in the wrong order.

Newborn: Okay, so Kasparov loses the match four to two.

Levy: Three and a half, two and a half.

Newborn: I'm sorry, three and a half, two and a half. And Deep Blue is king. Subsequently, there's been two major matches played by computers against Kasparov and against Kramnik. These both ended in draws.

Levy: Two against Kasparov and one against Kramnik.

Newborn: There's been two with Kasparov? Okay, I've lost track.

Levy: Yes.

Newborn: And they were both draws with Kasparov?

Levy: Yes.

Newborn: So we've had three major matches, and they're all draws. So in retrospect, does Deep Blue's victory look like a fluke or does it look like it has a little more substance than a fluke?

Levy: I think it has more substance than a fluke. I think Deep Blue deserved to win the '97 match in the sense that it scored three and a half points out of six games, and it played like a genius, like a strategic genius, in game two. It played with great resilience in games three, four and five, and it didn't really have to do very much in game six, because Gary threw himself on the sword. So I think the victory in that sense is deserving. It's unfortunate that Kasparov's psyche wasn't in good shape for game six of the '97 match, because then we would have seen a real fight, and who knows what might have happened? Deep Blue might still have won, or it could have been a draw or maybe Gary would have won. But certainly, I think Deep Blue deserved the victory in the '97 match, even though the way that it finally ended was unfortunate. Each of the subsequent matches has its own characteristic. First of all, there was Kramnik's match agains the Fritz program in Bahrain, and that was an eighth game match. Now, what happened in that match was that Kramnik started off killing the program completely. He scored two and a half points from the first three games and the match was virtually over. And it was very easy. And then Kramnik seemed to be replaced by somebody completely different. The moves that were coming - the way that the human was playing - were unrecognizable as being Kramnik. In the end, he lost two games to the program, and the match was tied at four-four. He said afterwards - people of course were saying to him, "Well, how come?" And he was saying things like, "Well, I was very tired after three games." Now, you can believe that if you want to. And a lot of people do believe that. I'm not totally convinced, I must say. There have been various rumors about why Kramnik would draw that match, having been winning so convincingly. I think it's an open question in my mind. I'm not saying that Kramnik deliberately drew the match, having been two points ahead; I'm saying it's possible and I wouldn't be completely amazed.

Newborn: What would be to his advantage to draw the match?

Levy: Well, Bahrain is a very wealthy country, and the sponsors wouldn't have wanted him to cruise to victory in the way that he was after three games. It wouldn't be very good for the sponsors. And he might have had in mind the possibility of a rematch. I'm just repeating rumors that have been uttered by other people, and saying that I wouldn't totally discount those rumors. It's almost impossible to understand how a world champion player at that level can dust off an opponent with two and a half out of three, in the way that he did - and the half point the program scored was because Kramnik was just feeling his way. It's impossible to believe that a normal top-level Grandmaster could then go on and loose two games immediately, including one with a horrendous blunder of the sort of that Kramnik would never make in a million years, normally. Okay, maybe he was psyched out in some way, maybe he was tired; he claims he used up a huge amount of energy in the first three games. I don't believe it.

Newborn: What about the other Kasparov match?

Levy: The other Kasparov matches were real tough fights, both of them. The first match was quite interesting; it was a six-game match played against the Junior program, written in Israel, and it was

originally scheduled to have been played in Jerusalem. When the match was being negotiated, Kasparov invited me to go to Jerusalem for the initial discussions, and we discussed the rules a bit. There was a press conference there, and it was all set to take place in Jerusalem. But then it turned out that there had been some miscommunication, and the money that was expected to be found in Israel couldn't be found. Even though the mayor of Jerusalem was completely behind the match. So other venues were being talked about, and there was a possibility of holding the match in Florida; then there was somewhere else being spoken about in the States - I can't remember where. And finally, of course, it came to New York, which is the best place to hold such an event. That was a six game match; we discussed the rules for five months. Gary asked me to form a committee of experts to put together the rules. The committee consisted of chess Grandmasters - at least one chess Grandmaster, Yasser Seirawan; also computer chess experts. And then Gary looked at various iterations of the rules, commented on them, and the Israeli programmers looked. We negotiated this for five months. I would get phone calls from Gary at dinnertime and spend half an hour on the phone on tiny little point of service.

There were some really interesting ideas that came up in the rules. One point was that very late on in the negotiations, Gary decided that he didn't like the idea of playing against an end game database; he didn't like the idea that if he reached a position that happened to be in a massive database of end games, that the program had at its disposal, that the program could play perfectly and he couldn't. And he also said - and this is certainly true - that that would take away the scientific aspect of the struggle, because it would no longer be a struggle between man and an artificially intelligent program; it would just be a struggle between a man and a piece of code that looks up a table of entries. So he didn't like the idea, and so he wanted a rule put in saying that - effectively, that if he reached a drawn position, a position that was in the database that was a draw, that the game would end there; he wouldn't have to show that he could draw it against the program. And there were some points from the other side, from the Israeli side.

It really got quite tense at some point, and even, I think, as close as two or three weeks before the match started, I wasn't absolutely a hundred percent certain that an agreement was going to be reached, and so I was getting slightly nervous. I didn't, in fact, buy my plane ticket until quite near the date for the match, because I obviously didn't want to make a commitment to go to New York for something that might not happen. Finally we agreed the last point, about ten o'clock at night London time the night before I was due to fly. I think the Israelis were already in the air; they had agreed the final point with me, and I spoke to Gary around ten at night. And I said, "Look, Gary, this is it. I think this is reasonable." And he said, "Okay." So I produced the final amendment; I sent it round to everybody; the next morning I got on the plane, we turned up in New York.

And then, because of what had happened in the '97 match, and Gary's suspicions about IBM, the committee of people, five people - was it five? - yeah, five people on the committee who put together the rules, were actually in New York during the match to oversee the fairness of the match. And what three of us had to do - there was myself, there was Jonathan Schaeffer, who is a longtime expert in the world of chess and computer games, head of the Computer Science Department in the University of Alberta in

Edmonton, and he runs the world's largest computer games development group in academic life. So he's very, very expert. He was there; we had Peter Wilson, who was the chairman of the FIDE Commission on Computer Chess. Our job was to sit in the room where the computer was and watch on a monitor every iteration on every move, so we could see exactly what the program was thinking. The purpose of that was so that we would be able to tell if suddenly the program was thinking about move A, and then for no explicable reason it suddenly started thinking about move B. So we were then in this room with the computer, the Israeli guys there, loads and loads of cables. Gary was playing in another room about six feet away. And we sat there. Now, for us and for people who understand chess, that's the most interesting way to watch the match, because the audience in several floors below us, although they could hear running commentary from Grandmasters and other experts, they didn't know what the program was thinking. The only people who knew what the program was thinking was the Israeli programmer in the room with us, and us. Every now and again, Kasparov's mother would come in and say, "Is everything okay?" She was very concerned. Of course everything was fine; there was no problem. But that match was very exciting, particularly in one game where the program unleashed a piece sacrifice very early on, with the Black pieces, which came as a complete shot out of the blue. About ten seconds before it made the move sacrificing the piece, Jonathan Shaeffer said, "What happens if it plays Bishop takes H2?" We also started looking at it, and then ten seconds later it actually played the move. It was quite uncanny, that Jonathan thought of it just as the program was making the move. He didn't think about it because the program had put it on its screen, because the program hadn't. It had been looking at something. And then the program changed its mind, for reasons which we could understand, seeing the screen. Everything was completely above board; it was a very nice piece sacrifice; and it led to a draw. And that was very exciting. I think at the end of the match, I think a draw was a fair - a tied match was a fair result. I think the program played very well; overall, Gary played a bit better. But they were close. And I think both sides could be satisfied with the result.

Newborn: So it was the year 2005 -

Levy: No, that was 2003.

Newborn: Today is 2005.

Levy: Sorry, can we go back because that -

Newborn: All right, go back.

Levy: Okay, that match was played I think in February 2003. It was played in the New York Athletic Club in Manhattan. And then later in the year, there was another match between Gary and a different program - this was Fritz. It was called Deep Fritz, because it was running on parallel machines. That was also

played in the New York Athletic Club. This was only a four-game match. And again, I was there to look at the computer screen and to make sure that everything was fine. And everything was fine. Again, the match was drawn. Again, my feeling at the time was that Gary was playing better overall chess than the program, but they were quite close, and I think a draw there was a fair result as well.

Newborn: So we're two years later, and is it fair to say that man and machine are neck and neck?

Levy: I think from Gary's last two matches, I think it's reasonable to say that man and machine are neck and neck. However, there is a new kid on the block. In fact, there are two or three new kids on the block. The one that's impressed most so far is a program called Hydra, which was developed by an Austrian programmer, Chrilly Donninger. He has been in the world of computer chess for many years; he's taken part in many of our world computer chess championship tournaments. He's a very, very smart guy indeed; he's got achievements in different areas of science, and he's a genius programmer. He built a piece of hardware, special-purpose hardware, in much the same way that the Deep Blue guys did. But he built it using what are called FPGA's, Field Programmable Gate Arrays, which are chips that you can program and get a copy of the chip immediately. Normally with the technology that was used for Deep Blue, you design your chess chip and you send it off to the fabrication plant, where it's made into silicon, and it comes back several weeks later. With an FPGA you can say, 'Oh, I'd like to change that,' and you can change it, you run the program overnight, and the next day you've got what you want. So the development of systems using FPGA's is much quicker. And Chrilly knew how to design such a chip, and he's put together a monster of a machine called Hydra, that runs with multiprocessors. And in February of this year it did very well in the computer chess tournament in Paderborn; it's an annual event. And in June of this year it scored a stunning success against a British Grandmaster called Michael Adams.

Now, Adams has for many years been in the world's top ten in human chess. He's a very, very strong player indeed. He's not quite at Gary's level, but he's close. He's one of the few players in the world who would have a serious chance against Gary in an individual game. He wouldn't have a chance in a long match, because in a long match, the stronger player inevitably comes out on top. But he's one of the few players in the world who can sit down and give Gary real trouble at the board. Adam was beaten five and a half to a half. He got one draw out of six games. He was completely and utterly demolished in game after game after game. Like watching a steamroller rolling over a poor furry animal. The only game that he managed to draw, he came up with a strategy to sacrifice - what we call the exchange, a rook for a minor piece; to make a material sacrifice in order to create a blockaded type position where the program couldn't really get through. And the only way the program could have got through the blockade would have been to give back the material, which programs just don't do; they're too materialistic at the moment. A human player playing it that sat in that position would have had a good chance, I think, by giving that material. But he knew that the program wouldn't do it; he knew that was the type of position in which programs don't really understand what's going on. They say, 'Oh, hi, guys, I'm Exchange F, I must be winning." They carry on, move after move after move, 'I must be winning, I must be winning, I must be winning.' Eventually they get to the point where they play - in the ultimate case, which didn't happen here

- they get to the point where they play fifty moves without a capture or a pawn moves, and the game's a draw. So Adams made one solitary draw, but he was annihilated. That showed, despite the comments that have come from other Grandmasters saying he wasn't properly prepared, which may be true - that shows in my view very clearly, that Hydra is streets ahead of all the other programs we've seen playing against top human players. It would be really interesting now for Gary Kasparov to come out of retirement, because he retired from human chess earlier this year. But it is known that Gary would be willing to come out of retirement and play a top program if the right conditions could be met, which is the right amount of sponsorship money.

That would be, I think, the mother of all man versus machine matches. That would be the strongest human chess player, still playing chess at the plus-2800 level -- he's still top of the ratings, even though he's retired -- against what is clearly the strongest program we've seen in man-versus-machine contests. Now, having said that, I should mention that three weeks ago, in the World Computer Chess Championship in Reykjavik Iceland, where Hydra was not participating because they now consider it a bit beneath them to play other programs - they think they're so much better - two new programs came along, written by amateur programmers. One called Fruit, written in France, and one called Zapper written in the USA, both of which ran away with the tournament, ahead of Shredder, the former World Champion; ahead of Junior, which was at that time the reigning World Champion. Both of those programs are clearly very, very strong, plus 2700. Until they play matches against a top human - Zapper has played a match against a not quite top human -- but until these programs play matches against a very strong human of Adams' caliber or better, we won't know how good they really are against the top players. But clearly they're contenders. I would very much like to see a match between Hydra and Gary Kasparov. I think it would be very exciting for the chess world, and it would show whether indeed Hydra has made the big leap forward since Deep Blue. The general feeling amongst people who've seen the program play and people who've been following world computer chess championships is that Hydra and Junior and Shredder are all stronger than Deep Blue was at its best.

Newborn: So we've got to the point where neck and neck is not too unreasonable to say. How do you see things five to ten years from now? Does the human race have some chance to stay in this competition, or are we going to be left observers?

Levy: I think really we're going to be something of observers, unless we come up with a meaningful type of contest. The problem is that programs are getting better and better. They are either as good as, or possibly even better than, the best humans that have ever lived. So the contest to some extent will lose its meaning. I think the last meaningful contest, in my opinion, will be if Gary were to play a match with Hydra, and possibly have a rematch clause in the contract, to allow the user the right of a rematch within a year. I think that could be the end. I think it's possible that Gary might hold his own. I think he will have a great deal of difficulty. But I think that even if he doesn't lose then, I think we're within a year or two of the time when no human Grandmaster will ever be able to win a level match against a top computer program played at a normal slow pace.

That brings the question: What do we do next? How can we make this contest interesting? In my view, we should go back to the nineteenth century. What happened in the nineteenth century was that if I was a really strong master and if you were a less strong master, I would give you odds; I would give you a start. I would take off a pawn or two pawns or sometimes even a knight and occasionally even a rook. If you look at the games published from the second half of the nineteenth century -- from the middle of the nineteenth century onwards, really, until the late nineteenth century -- you'll see that a lot of the top players played some of their peers at odds. Paul Murphy, the famous American who was clearly the world's strongest player in the late 1850's - many of his most beautiful games were played at odds. In my view, there is no reason why we shouldn't take a lesson from that, and say, Okay, what we'll do now is, we'll have matches in which the program will give a pawn to the Grandmaster. The program can play White and give one pawn, probably the A pawn seems to be the least valuable pawn to give away. And let's see if top Grandmasters can hold their own against the program when they get a pawn to start. It may be the case that the top Grandmasters now could actually beat the best program with a pawn start. It's quite possible. But the time will come when - and it may not be many years down the road - when even that will become difficult, because of course, programs are getting stronger all the time. They're getting stronger; they're getting smarter. I think that could be another interesting scientific investigation. How long will it be before a program can defeat the top Grandmasters when giving a pawn? And once we get to that stage, the question then arises, well, can any program actually give two pawns? Well, that, I think, is arguable. I think one pawn - my feeling is that [with] one pawn, programs will eventually be able to beat the world's best. Two pawns, they might be - it's slightly doubtful. Any more than two pawns, I think it's impossible.

Newborn: How much do you think Kasparov could spot you, and beat you?

Levy: In a slow game played at tournament speed? Probably two pawns. I don't think - I'm sure he couldn't - well, when I was at my best, I mean. I'm not talking about now, because I'm retired. At my best, he could certainly have given me one pawn and maybe two. He played a charity match in London a few years ago against somebody who was not quite as strong as I was at my best, and Gary gave this guy two pawns in every game. It was a different two pawns each time, and Gary won the match.

Newborn: Could he spot you a bishop or a knight?

Levy: No, no, no way. No way.

Newborn: So will the game of chess ever be solved? Checkers is about to be solved.

David Levy: Checkers is about to be solved. I don't believe that chess can be, because the size of the tree is too big. But having said that, you never know. I mean, to say that something is impossible is

rather unwise in the world of advancing technology, because the growth of science and technological progress are exponential. So who knows what might happen fifty years from now, when we have DNA computers and quantum computers? It might be solvable. My personal belief is that it won't be solvable, but by then, we will long since have past the time when any human has a chance against the Grandmaster program. The programs will simply be too good. Gary himself said at the end of his second match in 2003 that he foresees the day coming when a Grandmaster will be happy to win a single game against a program in an eight-game match.

Newborn: That's scary.

Levy: It's very scary.

Newborn: We just have a few more minutes, and I just want to get onto a few last somewhat philosophical questions. How would you define the word intelligence?

Levy: This is a very emotional subject, and there are so many different forms of intelligence. There's the form of intelligence that allows people to do well in IQ tests. There's emotional intelligence. One often finds that people who have a very high IQ have a very low emotional intelligence. So it's a subject which, as you know, has spawned many hundreds of books, learned articles, and philosophical discussions. I think it's beyond really the scope of this interview for me to define intelligence.

Newborn: We can try, or would you prefer not to?

Levy: I think intelligence is a combination of things. It's a combination of mental agility and the ability to solve problems that are not necessarily familiar problems, to generalize from past experience and to use that generalization to help solve new problems, based on past experience. I think these are the key factors.

Newborn: Would you attribute intelligence to all forms of living creatures, insects?

Levy: It's difficult to know how far one can go down the hierarchy and still attribute intelligence. Within their own species, one might say that some insects are more intelligent than others. I don't know. I've investigated this problem a little, and again, it gives rise to heated argument amongst philosophers and psychologists.

Newborn: I'm not going to pin you down any further on that. We have just a couple minutes. Do you have any final things that I should have asked you, that perhaps you'd want to say a few words about?

Levy: I have a few.

Newborn: I know we were skipping over a few; let's go on. The game of chess is somewhat finished from the standpoint we know what it's going to take to get a world class… we have a world class chess program. What about GO? Have you got any insight into GO at this point?

Levy: Yes, GO has been making slow but steady progress for the past twenty years. If you look at the strength of the best GO programs - and GO players have their own rating system - if you look at the strength of the best GO programs twenty years ago, and you look at the strength now, the difference is consistent with an improvement of about half a Q a year. Now, a Q is a rank in GO. Really weak players start off at something like 32 or 35Q; as they improve they get down to 1Q, and then they go from the Q scale to what's called the Dan scale, that goes up from 1 to 9. And I think programs in the last twenty years have been improving at an average of about half a Q a year, and my friends in the GO world tell me that's still the case; they're still improving at about half a Q a year. If that rate is maintained, then it will be about 35 years before the best programs become as strong as the Kasparovs of the GO worlds. So in other words, you're looking at the year 2040, approximately.

Q: And how do you think the GO world is preparing for this?

Levy: I think there's a lot of skepticism in the GO world, as there was in chess. In the early days of computer chess - and this is quite an interesting subject to discuss - the attitude of the strongest players was largely one of derision. You could take what I was saying to John McCarthy when we made the bet as a sort of typical example of derision, not from a top Grandmaster but from a Master-level player. We just didn't believe it was going to happen, and we certainly didn't believe it was going to happen fast enough. I remember very well in 1977, your famous statement, Monty. You said - during the World Championship in Toronto - you said that Grandmasters used to come to computer chess tournaments to laugh; now they come to watch; soon they will come to learn. I think “soon” is of course a relative word, and it didn't happen as soon as you expected, but it did happen that Grandmasters came to learn. I think the same sort of thing is going to happen in other areas; in computer GO, for example.

Newborn: These questions are not quite as sequential. But if you were to be Kasparov's advisor for this next match, what would you do?

Levy: I would advise him to use a little bit of the original David Levy strategy, and instead of playing main variations of openings - variations that are well-known and certain to be in the program's openings book - that he should perhaps consider trying to create positions where long-range strategy is more important. Now, that could have a big downside. The advantage from Kasparov's point of view of playing a really well-known opening is he can play the first ten or fifteen or maybe even twenty moves instantly, which leaves him completely fresh for the middle game, and it also leaves him with a lot of time remaining on his clock. Whereas if he has to start thinking for himself from the beginning, he'll use up more energy and he'll use up more time in the opening. On the other hand, programs do seem to benefit themselves from playing openings that are in their books. It may be that programs benefit more than humans do, in which case it's worth looking at the possibility of just creating very quiet positions from the opening; positions that are not in the program's book, and expecting programs to make not quite the best moves, from the point of view of long range strategy.

Newborn: Do you think that the human mind, Kasparov, is able to play at his best with a one-day rest between matches, or would he be better off with two or three days?

Levy: I think one day is enough.

Newborn: Because the major athletes of the world, for example, the pitchers, they pitch every fourth day. If they're forced to pitch much more than that, they're not at their best. Do you think the human mind is sufficiently flexible that it's back to its best with one day of rest?

Levy: I think so. If you look at the normal regime for Grandmaster tournaments and for world championship matches, the regime for world championship matches used to be four games a week. I think it still is; four games a week and three rest days. So for example, you play on Monday and Tuesday and then you have a rest day. You play on Thursday and Friday and you have a couple of rest days. That sort of regime isn't bad. Playing one game every two days I think is fairly comfortable for the Grandmaster. In tournaments, they play maybe four games in a row before they have one rest day. So I don't think one game every two days is at all onerous on them.

Newborn: Do you think that the computer has been good for the world of chess?

Levy: I think it's been very good for a number of reasons. Firstly, it stimulated interest in chess during an era when there's been some controversy in the organization of the World Chess Federation, and during an era when a lot of people were thinking that maybe chess was getting a bit boring, and that, you know: Where was chess going? Suddenly you have this whole new experience. It's also brought more money into chess, which is important for professional players and for tournament sponsorship. And because programs play very sharply and very tactically, I think it's actually brought about a change in the style

adopted by the top Grandmasters. I think Grandmasters now who practice -- they all practice with programs. I think they've become more interested in playing tactical chess, and better at it. If you look at the published games in chess magazines from tournaments of the last several years, there's a lot more tactics going on in Grandmaster games now than there was, say, fifteen years ago. So I think there's some of the benefits. Another benefit, of course, is that there are massive databases of such openings, which is not really artificial intelligence, but it is something that gives Grandmasters an opportunity to study and prepare for particular opponents, knowing exactly - you know, Newborn played the Knight [??] defense and his opponent did this, and Newborn did that. You can analyze the soul of your opponent's opening strategy with a laptop, and that's quite useful when preparing for tournaments. The other area of chess, of course, where programs have been very helpful, is in the end game. Because these endgame positions that have been analyzed completely by programs have taught Grandmasters things about chess that we didn't know. The first example where this became a classic was King and two Bishops against King and Knight. I think in that configuration, there were a lot of unknowns. There was the suggestion in the opening book that that was usually a draw, but in fact it turns out it's nearly always a win. So we've actually learned, as you predicted we would.

Newborn: Let's come to this final question. Do you have anything that I've missed asking you about that would be useful to get on record?

Levy: I think there's one very important question in the whole of this area, and that is: What have we learned about artificial intelligence as a result of the struggle between man versus machine and the progress in the history of computer chess? What I believe we've learned is this: Turing a long time ago came up with a measure of intelligence, or a test for intelligence, called The Turing Test, which is based on a human not being able to distinguish whether they're communicating with another human or with a computer. Carrying on a conversation through a computer terminal or a teletype or whatever with an entity in another room, and with two entities in two different rooms, not knowing in advance which entity was the computer and which was the human. Turing's argument was that if you can't tell the difference, then the computer is intelligent. The reason he said that was because conversation is something that requires intelligence, and even today there are no computer programs that can converse at the level of a three-year-old child, let alone an adult. Now, taking Turing's argument further, one could say that if you cannot distinguish between the chess moves produced by a program and those produced by a top Grandmaster, then in the realm of chess, that program is intelligent. It's artificially intelligent, but it's intelligent. I think the analogy works perfectly. Not everyone agrees, but that's my opinion. So the question then arises, the best programs all work now using brute force. They are not intelligent in the way they search the massive tree of possibilities. They have some rules of thumb, some heuristics, to help them speed up the search, but by and large it's a no-understanding, brute force search of massive numbers of possibilities. Two hundred million positions a second at the moment, and counting. Is this really intelligence, and what have we learned about artificial intelligence from the struggle? I think that this is an artificial kind of intelligence, because the result that's produced by these programs is the result that we normally associate with human intelligence, however you define it. You can go out into the street

and say to somebody, what do you need to be a good chess player? Almost everyone will say you have to be intelligent. And if you go out into the street and say to someone, do you think somebody really dumb could play top chess, almost everybody will say no. So I think it's generally accepted that chess is one of those tasks that requires a fairly reasonable degree of intelligence to play it well. Therefore, along with Turing, I think one has to say that to play chess at Gary Kasparov's level, or anything remotely approaching it, requires an artificial intelligence from a program. I think what we've learned in terms of AI is that one form of AI is just massive computation; a huge amount of computation with not very much chess intelligence. Transferring it to another task with not very much intelligence about the task at hand, but enough knowledge so that when you do something, millions and millions and millions of times, it somehow comes out in the wash to be a genius chess move, move after move after move. I think that's a lesson that can be learned for the future of AI, and it's my belief, as a result of this, that problems that have so far proved fairly intractable, such as machine translation, I think problems like machine translation and conversation will ultimately be solved by programs using massive amounts of data and not a huge amount of intelligence. A friend of mine, Yorick Wilkes, who's a professor of computer science at Sheffield University in England, is one of the world's foremost authorities on natural language processing, on conversational programming, and programming and translation. He said to me that in his view, the key to artificial intelligence is a very large amount of data and very little programming. I suspect that he's going to be proved right in the future. That's the way AI is going to go.

Newborn: Sounds like a religious conversion on your part.

Levy: It's true. When I started, I was a complete infidel, a complete unbeliever. When I shook hands with John McCarthy and Donald Mickey in August 1968, I guess I was probably willing to believe that one day it would happen. But “one day”; I certainly thought “one day” at the time would be very, very far off. I think I would even have said then that I wouldn't lose a match within twenty years, if I had been asked. But you know we were talking about ten. But I've become converted by watching things happen. I've become converted by watching progress in computer chess and other computer games; I've been involved actively in the world of natural language processing. I won the Loebner Prize in 1997, which is a kind of world championship for conversational programs, for my program. It was a very poor conversationalist; it just happened to be the best of a bad bunch. So I've got some familiarity with other areas of AI. I've seen areas where there's been huge progress. Some of the expert systems programs, for example, which are a large amount of data, and not very much code. If you look at programs even a long ago as the late sixties, programs like Dendral, programs like Mycin… Mycin was remarkable. It was a program in the late 60's and 70's that could do a better job than the leading experts at Stanford Medical School in deciding what regime of drugs to give people with certain classes of disease. Programs like that are going to become more and more prominent in the future, but I think they're going to be based on a lot of data and not very much intelligence.

Newborn: Last question. Do you see little robots running around with lots of intelligence in the next fifty years?

Levy: Absolutely. I've just finished a book which is about to be published called Robots Unlimited, in which I sort of cover AI and artificially intelligent artifacts going back hundreds of years. But at the end of the book, the last few chapters, I cover the subject of what robots will be doing in the next fifty years. I believe that just as we now see software which is intelligent enough to play a world champion level game of chess, and there is also software around that can compose music indistinguishable from Mozart's or Chopin, and which can paint and draw as well as many artists or better than many artists whose work are exhibited in art galleries and exhibitions, I think that within fifty years we will see programs that will accomplish every intellectual task known to man at least as well as we can. If you imagine that kind of intelligence in an entity, a robot, that looks like a human being… If you look at a film like Stepford Wives, where you have creatures that for all intents and purposes are human, imagine being able to be able to have a partner, a wife, a lover, who can converse with you on any subject under the sun, in any language, at any level that you wish. A robot that can have any persona that you want: the persona of a lumberjack from Alaska, or a punk rocker, or a deep sea diver, or a composer of classical music, or a poet. Any persona you want, any personality you want will be programmable. Any level of knowledge and understanding will be programmable. Emotion is already being programmed into toys that we buy today for our children; the AIBO dog from Sony, for example. Even the little Tamaguchi had some elements of personality in it. People in fifty years time, in my view, are going to be falling in love with robots and marrying them, having sex with them. The robots will go off to the robot factory and make little robots. That self-reproduction of robots is already happening in the United States, this year. In April of this year, two computer scientists who had been developing robots for many years announced that they now have a robot that can pick up pieces of itself and assemble another version of itself. That's the beginning. I think what will happen when robots reproduce is that your robot will go off to the factory, it will like certain characteristics of yours, like the color of your eyes or your voice or something, and it will come back from the factory with a new robot that…

END OF INTERVIEW

