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IBM's Chess Players: On AI and Its Supplements

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This article investigates the ways in which the reporting of technological developments in artificial intelligence (AI) can serve as occasions in which Occidental modernity's cultural antinomies are played out. It takes as its reference point the two chess tournaments (in 1996 and 1997) between the then world champion Gary Kasparov and the IBM dedicated chess computers *Deep Blue* and *Deeper Blue* and shows how these games of chess came to be seen as an arena where fundamental issues pertaining to human identity were contested. The article considers the dominant framing of these encounters in terms of a conflict between two opposed categories—"human" and "machine"—and argues the essential role of human agency, the human supplement, in the performances of machine intelligence.

Keywords agency, artificial intelligence, computer chess, *Deep Blue*, human identity

> **David:** Open the pod bay doors, please, Hal... Open the pod bay doors, please, Hal... Hello, Hal, do you read me? ... Hello, Hal, do you read me?... Do you read me, Hal?... Do you read me, Hal?... Hello, Hal do you read me?... Hello, Hal, do you read me?... Do you read me, Hal?
> **HAL:** Affirmative, Dave, I read you.
> **David:** Open the pod bay doors, Hal.
> **HAL:** I'm sorry, Dave, I'm afraid I can't do that.
> **David:** What's the problem?
> **HAL:** I think you know what the problem is just as well as I do.
> (*2001 A Space Odyssey* [*dir.* Stanley Kubrick, 1967]; screenplay by Stanley Kubrick and Arthur C. Clarke)

Debates over what "intelligent machines" can, or cannot, do are often tinged with unease. This unease is the subject of one of the illustrations in Raymond Kurzweil's *The Age of Spiritual Machines* (1999, p. 197). The picture depicts a human figure (representing the "human race") deep in the throes of an existential crisis as he tries to identify those intellectual attributes that account for the superiority of human over machine "thinking." His endeavour appears to have been repeatedly stymied by the relentless "march of the machines."[1] with discarded propositions—"only humans can prove important theorems," "only humans can recognize faces," "only humans can pick stocks," etc.—that have fallen like autumn leaves in the winds of technological progress. Only a few such claims are still defiantly pinned to the walls. It is clear that his Canute-like[2] hope to hold back the technological tide is as futile as it is misconceived. Nevertheless, his anxiety remains understandable. For a long time Occidental culture defined "thinking" as something that only humans could do, and "intelligence" as something that only humans could posses. Thus the possibility of an *artificial* intelligence can be perceived as an erosion of what it means to be human, a boundary violation that generates feelings of anxiety and unease (Douglas, 1966; Bloomfield & Vurdubakis, 1997, 2003). As Isaac Asimov notes, "the ultimate machine is an intelligent machine," and our great fear is "that it will [ultimately] supplant us" (1981, p. 136).[3] Kurzweil (1999) offers a timetable for when we might expect that to happen.[4] We could therefore name (after Asimov) the cultural unease that attends the notion of an artificial intelligence "displacement anxiety." Of course, the anxiety experienced by the human subject when faced with evidence of the agency of the object is a frequently recurring theme in Western popular culture, from Mary Shelley's (1992) *Frankenstein* to the *Terminator* (dir. Cameron, 1984, 1991; Mostow, 2004) and *Matrix* (dir. Wachowski & Wachowski, 1999, 2003) film trilogies. Perhaps its most memorable dramatization is in Stanley Kubrick's (1967) classic 2001 and in particular the famous scene in which the on-board computer HAL 9000 denies astronaut David Bowman reentry into the spaceship (quoted earlier in this article). The creation thus attempts to displace its creator, evicting *him* from Paradise.[5]

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We could say that AI is as much a cultural construct as it is a techno-scientific research program. In fact, it was the former some time before it became the latter. As the celebrations and reflections that marked HAL's 1997 "birthday" have underscored, our collective understanding of what an "artificial intelligence" might be like owes perhaps as much to science fiction as it does to science (e.g., Stork, 1997).[6] Clearly, the media play an important role in this trafficking in representations. The esoteric (Fleck, 1979) character of most technical and scientific work means that the only way it ever reaches a wider public is through the intercession of various representational media (Suchman, 2007). In the course of such mediations, techno-scientific developments become invested with specific cultural meanings and significance by being put in the context of familiar stories. Dorothy Nelkin (1987, p. 2) goes as far as to argue that for most people "the reality of [techno-]science is what they read in the press. They understand science less through direct experience or past education than through the filter of journalistic language and imagery." However, such "popularization"—if that is the right term—is *not,* as often claimed, a mere rendering of scientific work into more digestible language. Rather, it constitutes a *literary* enterprise in its own right, one that uses particular technical and scientific developments as its sources of inspiration (Caro, 1997) while, arguably, also contributing to the shaping of cultural expectations regarding techno-scientific work (Fleck, 1979).

In what follows we attempt a critical examination of some aspects of what we might call the "literary enterprise of AI." More specifically, we focus on the 1996 and 1997 chess competitions between world champion Gary Kasparov and IBM's dedicated chess computers *Deep Blue* and *Deeper Blue*. These contests are typically viewed as epitomizing the process through which claims about what intelligent machines are, or are not, capable of, find their way—metaphorically speaking—from the wall to the floor of Kurzweil's distressed man (e.g., Dennett, 1996; Pandolfini, 1997; Cook & Kroker, 1997). In contrast, our aim is to investigate these tournaments as cultural events, as staged occasions for the rehearsal and dramatization of various philosophical and moral conflicts characteristic of Western modernity. Of course, imagery of conflict tends to be a rather overused commodity. Media accounts, in particular, often endeavor to drum up interest by (over)using the language of conflict to frame the otherwise "dry" techno-scientific "facts." And yet the success of such accounts in attracting readers and viewers (demonstrated by the migration from specialist to general news and media) crucially depends on whether they resonate with their cultural myths, their "deep stories": for instance, the conflict between creator and creation that forms a central element in the *Frankenstein* mythos (Turney, 1998). The (re)enactment of such conflicts in current cultural problematizations of artificial intelligence is discussed here in terms of the ongoing discursive (re)constructions of the "human," the "machine," and of "intelligence," the presumed sign of ontological difference between them. After a brief discussion of the historical antecedents, an analysis of the chess games played between the emblematic representatives of the two categories—Kasparov and *Deep(er) Blue*—is provided as a way of exploring how a game of chess came to be presented as an arena where fundamental issues pertaining to human identity were contested. Finally, the implications of this analysis for what we might call the "public understanding" of AI are discussed.

"LAST MAN STANDING"

The "facts of the matter" are already well known: In February 1996 in Philadelphia, the (then) world chess champion Gary Kasparov played a six game chess tournament against IBM's *Deep Blue*. Kasparov lost the opening game—the first time the world champion had lost to a machine in a game played at the classic rate (of 3 minutes per move)—but then went on to win the tournament by 4 points to 2. The year of HAL's birthday was also the year when the much anticipated rematch took place in New York. In May 1997 Kasparov played another six games against the second generation of *Deep Blue*, *Deeper Blue*. The match opened with a Kasparov win followed by a *Deep(er) Blue* victory in the second game. Games 3, 4, and 5 were draws and the computer proceeded to win in the sixth game when Kasparov resigned after only 19 moves following an uncharacteristic blunder. This clinched the tournament with 3.5 points for *Deep(er) Blue* versus 2.5 for Kasparov. Human mastery of the world of chess, observers proclaimed, had come to an end. The "Information Age," an IBM executive proclaimed, "has finally begun" (cited in Cook & Kroker, 1997).

Indeed, a look, however cursory, at the media coverage inspired by the two tournaments—"Deep Blue's victory proves giant step for computerkind" (Harding & Barden in*The Guardian,* 1997: 5); "IBM Chess Machine Beats Humanity's Champ" (Weber in *The New York Times*, 1997)[7] —is enough to show that something more was involved than the testing of the latest chess computer. Rather, in media narratives the tournaments provided a way of articulating broader cultural anxieties and expectations about the human sphere being encroached by the machine: "Remember, Neanderthal man once thought he was in control. If machines can master the Sicilian Defence (Scheveningen Variation), none of us is safe" (Moss, 2005, p. 21).

The tournaments were thus opportunities to reflect on Occidental[8] modernity's relationship with its technology, something that has provoked profound debate over a considerable period of time. Indeed, the issues currently

preoccupying the literary exponents and opponents of AI could be seen as prefigured in the Enlightenment fascination with the notion of the automaton and the associated reflections on the nature of the relationship between the natural and artificial, the human and the mechanical (e.g., Schaffer, 1994, 1995; Winner, 1985; Bloomfield & Vurdubakis, 1997). If we were to attempt a brief genealogy of the Asimovian "displacement anxiety" and of the role of the chessboard as a site for acting it out, a good place to start might be Descartes's Sixth *Meditation* (1968). As is well known, Descartes attempted to trace out the boundaries of humanity vis-à-vis animals and machines—entities with whom humans may appear to have a number of (for Descartes, superficial) similarities. Well-constructed artificial animals, Descartes argues, could in principle deceive the observer since animals are in effect little more than elaborate machines—as are human bodies. In contrast, automata constructed in a *human* form would be easy to expose since such machines would by definition lack the ability to reason and communicate with other human beings.

By the second half of the 18th century, however, even the powers of human reason itself did not appear immune from the mimetic powers of automata. Thus Julien Offray de la Mettrie (1912, orig. 1741) argued in his *L'Homme Machine* (Man, a Machine) that the differences identified by Descartes between humans and mechanical beings were mere differences of degree. Thus,

> [Jacques] Vaucanson, who needed more skill for making his [automaton] flute player than for making his duck, would have needed still more to make a talking man, a mechanism no longer to be regarded as impossible, especially in the hands of another Prometheus.[9]

As Simon Schaffer (1994, 1995) has shown, it was Von Kempelen's mechanical chess-playing Turk that best exemplified the ways in which the ability of automata to simulate human behavior was seen to challenge the ontological boundaries of reason. Throughout the 1780s the Turk toured the capitals of Europe taking on (and usually defeating) all opponents.[10] Catherine the Great of Russia and Napoleon are both said to have lost to the all-conquering Turk.[11] Commenting on the automaton's career in 1783, Cheterien de Mechel argued that

> The most daring idea that a mechanician has ever ventured to conceive was that of a machine which would imitate in some way . . . the master work of Creation. Von Kempelen has not only had the idea, but he carried it out and his chess-player is, indubitably, the most astonishing automaton that has ever existed. (reproduced in Chapuis & Droz, 1958, p. 364)

The automaton's 1784 London visit was accompanied by the publication of a tract by Von Kempelen's associate and biographer, Carl Gotlieb Von Windisch. Entitled *Inanimate Reason*, it challenged contemporary men of learning to solve the riddle of this mechanical Sphinx by identifying whether and what deception was involved. At the same time, the very possibility of "inanimate reason," however playfully employed, also hinted that the Cartesian boundaries of humanity were far less secure that had hitherto been imagined.

Over the next three decades the workings of the Turk, now owned and managed by musical engineer and impresario Johann Maelzel (inventor of the metronome), was the subject of both learned treatises and wild flights of fancy. It was during another visit to London that mathematician Robert Willis finally solved the puzzle of the Turk. On the basis of a detailed study of the dimensions of the apparatus he showed that there was enough space in the machine to conceal not a chess-playing dwarf, as many contemporaries had suspected, but a normal-sized human being. The real purpose of the complex mechanism was to produce sufficient noise to cover any sounds made by this hidden player.

Nevertheless, the invention of what we now call the "computer" (the name itself being the usurpation of a title formerly accorded to human calculators) renewed the specter of a mechanism crossing the Cartesian boundary that separated the automaton's world of mimesis from the human world of agency. Machines, it seemed, might soon come to fulfill the ambition of the modern Prometheus invoked by La Mettrie by also replicating human cognitive functions. Remarking on Charles Babbage's "analytical engine" (now routinely described as the first design for a digital computer), one eminent commentator, the physicist Sir David Brewster, suggested that:

> "Great as the power of mechanism is known to be, yet we venture to say that many of the most intelligent of our readers will scarcely admit it to be possible that astronomical and navigational tables can be accurately computed by machinery; that the machine can itself correct the errors which it may commit; and that the results of its calculations, when absolutely free from error, can be printed off, without the aid of human hands, or the operation of human intelligence. All this, however, Mr Babbage's engine can do." (quoted in Cohen, 1966, p. 113)

Whatever we might mean by AI, it reflects the belief that (perhaps all) "intelligent behaviour can be realised computationally" (McCarthy, 1999). Since the early days of AI research in the 1950s, playing chess was seen as a particularly accomplished feature of human problem-solving capabilities and as such has provided a suitable challenge for the ingenuity of AI researchers.[12] John McCarthy (2002, p. 6) quotes AI researcher Alexander Kronrod to the effect that "Chess is the Drosophilia of AI."[13] AI researchers, in other words, study chess for much the same reason geneticists study the fruit fly, as the gateway to greater things: the understanding (and replication) of intelligent

behavior. As Claude Shannon (1950, p. 55) put it in 1949:

> Although [Programming a Computer for Playing Chess is] perhaps of no practical importance, the question is of theoretical interest, and it is hoped that a satisfactory solution of this problem will act as a wedge in attacking other problems of a similar nature and of greater significance.

But there is another reason for the role chess has played in the cultural imagery of AI. In particular, chess has long been used to render "intelligent behavior" into a spectacle. As Hamilton (2000) argues, chess contests generate "the effect of spectacular intelligence." This makes chess an obvious means for *demonstrating* progress toward the eventual (if vague) goal of an "artificial intelligence." For instance, in 2001 HAL is seen playing chess and winning, thereby demonstrating the machine's status as an "artificial intelligence."[14]

The game of chess does, of course, carry a heavy load of culturally specific connotations of rational control, mental conquest and conflict[15] (e.g., Figure 1, which accompanied part of *The Guardian*'s coverage of the 1996 tournament between Kasparov and *Deep Blue*). This image of the chessboard as an intellectual battlefield is, however, by no means unavoidable.[16] In Italo Calvino's (1979) *Invisible Cities*, for instance, the chessboard is inter alia a site for a *meeting of minds* between those who come from different worlds: the Mongol conqueror Kubla Khan and Marco Polo the Venetian Merchant (see Kallinikos, 1995). It is, nevertheless, the imagery of combat that has tended to haunt discussions of machine prowess in chess. Thus astronaut Frank Poole's defeat to HAL in 2001 seems to symbolically presage the latter's murderous rampage in its attempt to take control of the spaceship—to which Poole falls first victim.

As early as 1958, Herbert Simon and Allan Newell had made the prediction that a computer would be world chess champion within a decade—thus representing the quest for AI in the form of a struggle between human being and machine. Clearly that prediction turned out to be overoptimistic, but the notion of chess as a site of contestation quickly became instituted through a series of contests or public demonstrations of which the

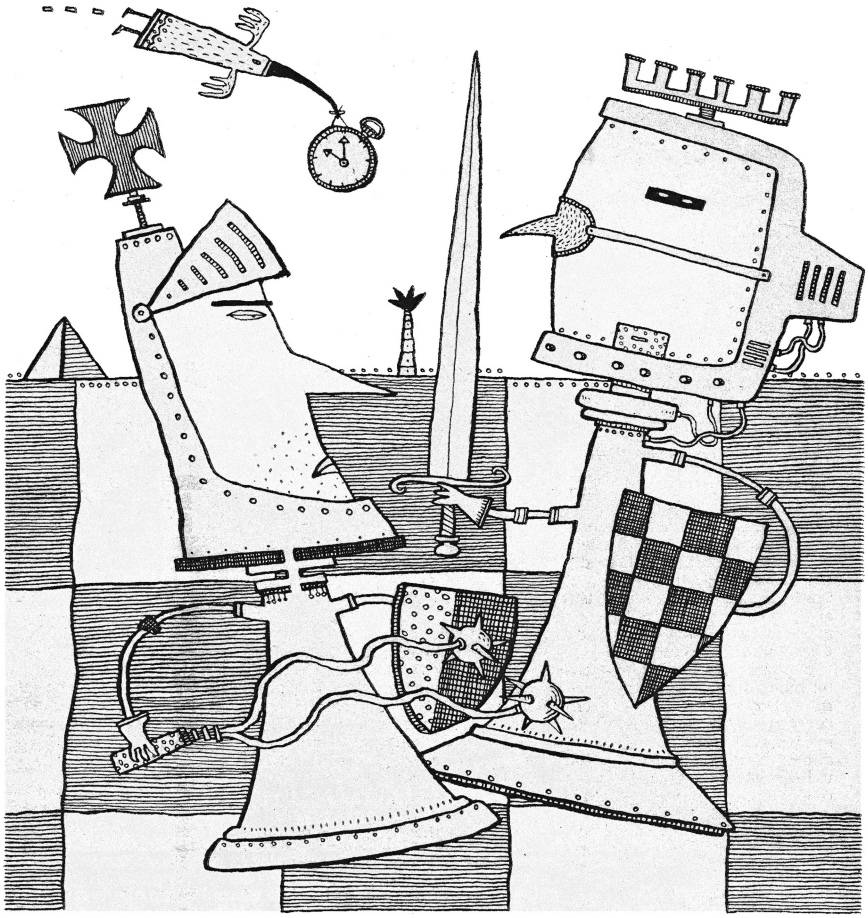

FIG. 1. Kasparov vs. Deep Blue (courtesy of Spike Gerrell).

Deep(er) Blue triumph over Kasparov is now billed as the climax.[17]

> One of the longest-running surprises in computing is just how difficult it has been to duplicate the ability of top human chess players with the aid of computers. For over thirty years now, computer scientists have been predicting that computers would be able to play better than any human 'within five to ten years.' After such a long period of failed predictions, it may seem that the alternative view, preferred by some psychologists and (understandably) chess players, that human judgement would *always* remain superior to algorithms, may be correct. It is my opinion that only the timescale was wrong, and that the 1990s will start a new era—one in which chess no longer belongs to the arena where human intellect reigns supreme, but is transferred to the growing domain of intellectual tasks performed best by machine. (Beal, 1991, p. vii)

For Herbert Simon it was clear that whatever the official IBM line might be, *Deep Blue* was a realization of the sort of machine he had anticipated some 30 years previously. Commenting on IBM's evident preoccupation with the *computational* aspects or qualities of *Deep Blue*, Herbert Simon (Simon & Munakata, 1997) emphasized its *knowledge* of chess. During those 30 years, one of the principal opponents of the view that "it's only a matter of time" had been Hubert Dreyfus, a persistent critic of the claims of what is sometimes referred as "the strong program" in artificial intelligence research (e.g., Dreyfus, 1972; Dreyfus & Dreyfus, 1992). In a contest staged at MIT in 1968, Dreyfus was himself beaten by a chess program—*MacHack*.[18] "L'Affaire Dreyfus," as it has come to be known (McCorduck, 1979),[19] immediately became a powerful metaphor for the coming victory for the AI research program over its detractors.

More than two centuries after Kempelen's Turk and Windisch's provocative tract, we are still, it seems, wrestling with the notion of the thinking machine. At the close of the 20th century, chess, where artificial intelligence, "inanimate reason," first dared speak its name, was once more providing a focus for Occidental modernity's ambivalent reflections on its emblematic object, the machine. The vocabulary used in the press coverage of the contests is revealing here. For instance, the IBM computers were frequently compared to monsters: for example, by David Levy in *The Guardian* (Levy, 1995); by Ray Monk in *The Observer* (1996); and (reportedly) by Kasparov himself (Tran, 1996b). In what sense do *Deep Blue* and *Deeper Blue* qualify as monsters? One obvious answer is that the term alludes to their awesome powers of calculation. Indeed, the topic figured prominently in media accounts of *Deep Blue*.

> The new system will be able to examine 50-100 billion positions during the three minutes allocated to each move. (Levy, 1996 p. 6)

> "We've got one of the greatest concentrations of computing power ever focused on a single problem working here." (J. Hoane, IBM scientist, quoted in Tran, 1996a, p. 12)

The calculative powers of *Deeper Blue* were, if anything, twice as awesome. According to Feng-Hsiung Hsu, IBM scientist, speaking to *USA Today*:

> "It can analyse 200 million chess positions per second, twice as many as last year (*ie*1996). At times, *Deep Blue* will evaluate up to 74 ply (moves by each player) in advance. Kasparov and fellow chess masters typically evaluate about 10 moves in advance." (Kim, 1997)

What is crucial, however, is that such (monstrous) calculative powers are seen as manifestations of what we might call a "cold reason," that is reason divorced from the human condition. Mary Douglas (1966) has suggested that "monsters" are to be understood as constituting violations of a morally charged and culturally rooted, classificatory order. Machines are commonly conceived as instruments of *human* will and extensions of *human* agency (Kallinikos, 1995). In contrast, the framing of the Kasparov–*Deep(er) Blue* competitions in confrontational terms hinted darkly at the prospect of an autonomous technology, a technology outside, or even contesting, human control.[20] Thus, the notion of the "intelligent machine" merges contradictory signifiers into a single identity. A machine, conventionally understood as an object designed for, and dedicated to, the assistance of human actors is here (re)presented as an independent agent. The representation and perception of *Deep(er) Blue* as something monstrous is thus an expression of its anomalous status as an entity which appears not to respect classificatory boundaries. In other words, *Deep(er) Blue* may seem monstrous to the extent that its properties threaten the boundary between subject and object, human agents and machines. Indeed, following his defeat in the second game of the 1997 rematch Kasparov is on record as describing *Deep Blue* as "an alien opponent" (quoted in Barden, 1997). We might see the philosophical heat and media interest attached to the "human versus machine" chess matches as a confirmation that what was seen to be at stake is nothing less than human self-understanding. People no longer compete with trains as they did at the dawn of the railway age, it is now taken for granted that machines are faster, stronger, etc.; what is disturbing for so many is the notion that the mind, the locus of free will and human choice, can be accounted for in mechanical terms and replicated in a machine, the representative par excellence of standardization and predictability (Kallinikos, 1992).

Against this backdrop, Kasparov appeared to have been anointed by the media as the champion of humanity coming forth to battle the mechanical monster, a title that he in turn appeared in all modesty happy to accept. Clearly *Deep* or *Deeper Blue* could beat most human chess players

easily. Indeed, this was why so much hung on the Great Human Hope, Kasparov the champion, who, it has been claimed, felt that it was his "mission to safeguard the chess world from the march of the machine" (Jones, 1994; see also: Wright, 1996).

> Gary Kasparov... sees himself as the "last man standing" in a mission to save chess from being turned into a mathematical formula.[21]

In fact the implications of the seemingly unstoppable march of computer chess machines were also rehearsed after a previous defeat for Kasparov in 1994. For example, in discussing the success of the relatively cheap computer program *Chess Genius 2*[22] in a match played at high speed,[23] Robertson commented in *The Times* (1994, p. 19):

> "If a few silicon chips can surpass one of the human' race's intellectual champions, what does it say for the rest of the herd? If it is not brainpower that sets us apart from our fellow-mammals, what is it?"

Kasparov himself echoed this argument in the run up to the 1997 rematch:

> "People want to believe that the world champion is somehow protecting the most sensitive area of our self esteem. Brain superiority is something that keeps us in charge of the planet. And if it is challenged in chess, who knows what will happen?" (interview with *USA Today*, Kim, 1997)

Echoing Descartes, the suggestion here is that challenges to the boundary between humans and machines—represented by contests between human experts and chess programs—resonate with the boundary between people and animals. Put another way, the concession of esoteric reasoning skills to machines could be read as a pointer to the mechanical basis of intelligence. Therefore it is not simply the human–machine boundary represented by esoteric skills such as chess that is at stake, but the very distinctiveness of the human in the evolutionary order of things.

Of course, another tenable reading of the Kasparov–*Deep(er) Blue* contest is to emphasize the fact that a computer is after all a human construction and that therefore its achievements might be cause for (human) celebration rather than existential angst. In this version, *Deep* and *Deeper Blue* stand out as pinnacles of *human* ingenuity and creativity. In fact, it is possible to find both gloomy and celebratory views of the contest within the same article (e.g., *Time*, Krauthammer, 1996). However, in the main, commentaries and media treatments of the contest predominantly employed a language of anxiety rather than celebration. Kasparov's defeat was claimed to represent a milestone in the zero-sum contest between humanity and machinery: "the defeat of human intelligence and the triumph of digital intelligence" (Cook and Kroker, 1997). Understandably, IBM was at pains to distance *Deep(er) Blue* from the *Frankenstein* complex as portrayed in 2001, the *Matrix*, or *Terminator*:

> This match is not about *competition* between people and machines. It is a demonstration of what makes us human beings so *different* from computers. (emphasis added)[24]

In addition, IBM's prematch and postmatch publicity made great play of how *Deep(er) Blue's* technology would soon be adapted for use in weather prediction, pharmaceutical research, financial markets and other applications beneficial to humanity (e.g., Hargrave, 1997; Kim, 1997).

THE RISE OF THE MACHINES?

> Who or what deserves the credit for beating Kasparov? Deep Blue is clearly the best candidate. Yes, we may join in congratulating Feng-hsiung Hsu and the IBM team on the success of their handiwork, but in the same spirit we might congratulate Kasparov's teachers, handlers, and even his parents. But no matter how assiduously they may have trained him, drumming into his head the importance of one strategic principle or another, *they* didn't beat Deep Blue in the [1996] series; Kasparov did. (Dennett, 1996)

However prominent the "(hu)man versus machine" billing might have been, there are reasons that make the task of identification of Kasparov and *Deep(er) Blue* with those ontological categories less straightforward than Dennett suggests or the press coverage would lead us to expect. These reasons can be glimpsed in the coverage of the less remarked upon aspects of the games. First, we have already mentioned, or alluded to, the fact that facing Kasparov across the chessboard was a succession of IBM scientists who physically moved the pieces as instructed by *Deep(er) Blue*.[25] But further, it is notable that before Game 2 of the first tournament, *Deep Blue's* handlers misplaced a file instructing the machine how to play the opening moves, thereby leaving the computer "to improvise" (Kim, 1997). On other occasions the operators placed pieces in the "wrong position"—we might say that the operators had not followed what the machine (*Deep Blue*) had said/instructed. In one such case Kasparov had already made his move by the time the "mistake" was corrected (ibid.). These instances, together with their interpretation as glitches or in terms of operator error, reinforced the notion that (logical) machines do not make errors whereas (fallible) human beings do.

Second, there were accounts of how *Deep Blue* had broken down during play in the fourth game of the 1996 tournament:

> Although the world champion confessed to being exhausted after the game, his opponent is also showing signs of strain and crashed after Kasparov made his apparently strong 25th move. But unlike the computer, Kasparov became

> visibly agitated and nervously paced the stage while IBM technicians took 15 minutes to repair the fault and re-establish contact with Deep Blue's base. The problem seems to have been stress, with the computer reacting adversely to Kasparov's cautious game. (Barden, 1996a: 26)

This commentary can be seen as a typical example of the tendency to anthropomorphize the machine, to project human psychological parameters onto it and thus analyze its "behavior" in such terms. In fact, Kasparov's reputed advantage over his usual (human) opponents due to his very stature in chess was frequently cited as one factor that would not have a bearing on his encounters with *Deep Blue*. Thus the cold logic of the machine would not be bowed in any way by his reputation. As things turned out, particularly in the second tournament, many commentators observed that this time it was Kasparov who was showing signs of psychological stress. Describing Kasparov's state of mind following the defeat in the second game of the rematch, Khodarkovsky and Shamkovich (1997: 203) state that he was "terribly frustrated" by his inability to fathom *Deep(er) Blue's* play and in consequence this affected his preparation for the next encounter. It would seem that the pressure really told in the final game:

> "The computer was beyond my understanding and I was scared." (Kasparov quoted in Tran, 1997, p. 1)

We could therefore conclude that a logic that could not be unfathomed by the world's greatest chess champion had indeed won out over frail human psychology. However, if we look a little further and again consider the role of the IBM team then matters are not so straightforward. To see why, we can usefully explore some of the machinations between the two camps that followed Kasparov's defeat in the second game of the 1997 rematch. After that game, which puzzled many other chess experts as well as the Kasparov team, the latter demanded to see the printouts kept by the IBM team. Kasparov wanted to understand the logic behind some of the moves. This was refused by his opponents. Such was the furor that allegations of cheating began to circulate in the media, suggesting that the IBM team had actually been offering human assistance *during* the game. Thus one headline ran: "Computer cheats at chess says champion" (*The Sunday Times*, 1997, p. 1). The allegation of cheating has an intriguing parallel with the case of Von Kempelen's Turk, where it was assumed by many that human agency had to lie behind the automaton's apparent powers at chess—there had to be a trick. In the case of *Deep(er) Blue* a similar line of reasoning and attribution of skills and agency was in operation: Either the computer must have received human help in the second game of 1997 because its moves were too human for it to be otherwise, or chess had indeed been reduced to calculation and Kasparov was doomed.[26]

The IBM team offered to make the printouts public, but only after the end of the tournament. The matter went to the Appeals Board and eventually the IBM team offered to pass the printouts of the second match to an independent third party, a computer scientist named Ken Thompson. However, Khodarkovsky and Shamkovich (1997, p. 209) argue that during the third game they had still not been sent to Thompson and that C. J. Tan of the IBM team had even asked whether they were still needed. As they saw it: "Once again C. J. Tan was stonewalling us." This "war of the printouts" (Khodarkovsky & Shamkovich, 1997, p. 202) was adduced to have been a form of psychological warfare against Kasparov. Whether this was intentional or not, it is evident that the role of the IBM team was more than that of mere operators. Indeed, even the nature of the IBM team—the exact complement of personnel—would seem to have been somewhat problematic. More specifically, Khodarkovsky and Shamkovich voice their concerns (1997, p. 204) about the precise role of the two grandmasters (Nick De Firmian and John Fedorowicz) who were secretly brought in as advisors—a factor that further contributed to the pressure on Kasparov: "[it] added fuel to our suspicions that unknowingly, we were facing the efforts of an untold number of grandmasters. Why was their participation kept secret?"

These arguments can be viewed in terms of a struggle over the identity and ontological status of *Deep(er) Blue*: If Kasparov's opponent was *just* a machine then why did its play seem so much "unlike" a machine at times? The converse of the supposition of cheating was the suggestion that *Deep(er) Blue* could play real chess:

> "The scientists say that Deep Blue is only calculating, but it showed signs of intelligence in our second game." (Kasparov quoted in Barden, 1997, p. 25)

This relates to a third aspect of the blurring of categories in the Kasparov—*Deep(er) Blue* encounters—namely, the continuity of the machine. It seems that to a certain degree *Deep(er) Blue* was actually reprogrammed in between games in order to try and prevent Kasparov from exploiting any perceived weaknesses he might have exposed in earlier games.[27] Indeed, reflecting on the victory at the end of the 1997 rematch and the improvements to *Deep Blue*, the IBM team noted that as well as *Deep(er) Blue's* increased computational power and additional chess knowledge, they had also developed their ability to change parameters between games.[28] This lack of transparency concerning the computer's programming in any particular game, and thus the logic behind the moves chosen, was another source of the intense frustration experienced by Kasparov in seeking to identify its Achilles heel.

Fourth, it is useful to focus on the games that were drawn. The rules governing each of the tournaments stated:

> The operator may offer a draw, accept a draw or resign on behalf of Deep Blue. This may be done with or without consulting Deep Blue.[29]

Shortly after the first tournament, in an interview with *Scientific American* magazine, IBM team member Murray Campbell stated: "The computer doesn't ever accept draws. If we want to, we can accept a draw, but it will never accept a draw. It's in the rules."[30] Accordingly, we can examine the matter of how draws were offered (or rejected) and thus how the drawn games were achieved—not in terms of chess play itself (that is the specific moves which precipitated a draw), but rather as an *agreement*. For example, the fourth game of the 1996 match was drawn, but only after some interesting twists. Writing in *The Guardian*, Leonard Barden (1996a: 26) relates what happened:

> At move 41 he (Kasparov) had the ignominy of having his draw offer declined but then he fought back with a rook-for-knight sacrifice and accepted a move-50 draw proposal *from Deep Blue's operator*. (emphasis added)

This was followed by an even more telling incident in the fifth game when after 23 moves Kasparov offered a draw. Again, we refer to *The Guardian*'s chess correspondent to describe what happened next:

> The machine was not programmed to respond and, *after its operator declined the proposal* "*in the interests of science*," it made a series of weak moves and was soon a bishop down. (Barden, 1996b, p. 21, emphasis added)

Kasparov went on to win the game.[31]

A similar pattern emerges if we examine the draws in the 1997 tournament:

> after completing his 48th move... Kasparov offered a draw to Deep Blue's Feng-Hsiung Hsu (one of the IBM scientists). Hsu conferred briefly with other members of the team, then accepted.[32]

What is important about such instances is the way in which they illuminate the nature of the relationship between the human beings involved and the computer. Thus, the offering and acceptance (or rejection) of a draw was a matter of judgment for the human operator and the rest of the IBM team. A fifth but related area concerns the matter of how games are won or lost. For instance, the sixth game of the 1996 match (won by Kasparov) did not result in an actual checkmate:

> Deep Blue's operator had little choice but to resign, since all the Black pieces were tied down on the Queen's side, leaving the King virtually defenceless.[33]

In other words, the "operator" interpreted the position on the chessboard and decided that further play was pointless. Again it was the operator's "human" initiative that was involved in resigning the first game of the 1997 tournament when the position seemed futile: "on move 45 . . . the Deep Blue team tendered its resignation."[34]

Finally, and concerning the games that were won, De Firmian (1999, p. vii) (U.S. chess champion and one of the grandmasters recruited in *Deeper Blue*'s winning team) provides a significant clue when he states:

> Lest history evaluate this epic "Man vs Machine" contest incorrectly, Kasparov played much worse than usual, trying a faulty anti-computer strategy when he would likely have won by normal play. I had a special perspective in this match as I worked with IBM on this project *and set Deep Blue's opening moves for its two victories*. In these games the computer emerged with a large opening advantage (before it even began to "think"), which put Kasparov in a hole. Chess openings are very difficult for computers *unless they simply repeat human moves*. Imagination and strategic thinking will always be two strengths humans have over computers. (emphasis added)

Put another way, De Firmian is in essence claiming that it was because of *him* (as the one who set the opening moves) that *Deep(er) Blue* was able to beat Kasparov in 1997.

Taken together, these features of the two tournaments indicate the difficulty in sustaining an account that consistently represents the matches as being between two distinct or (pure) categories—human and nonhuman agency. It is possible of course to analyze Kasparov's role in the same terms we have applied to *Deep Blue*. Accordingly, Kasparov could be viewed as the front man for a team effort—including computers as well as other human beings. On the one hand, Kasparov had a team of advisors though it would appear that their advice was not always appreciated. For example, Tran (1997) reported in *The Guardian* that in the postmortem of the 1997 tournament Kasparov noted his poor preparation as well as "bad advice, saying his greatest mistake was to listen to computer specialists." On the other hand, Kasparov has developed his game via a PC chess program called HIARC:

> "These days all chess professionals use computers to check their analysis. That's exactly what I do. . . . Today it takes me ten minutes to do what took five hours a few years ago" (Kasparov, interviewed in USA Today, (quoted in Kim, 1997)

Indeed, commenting on the preparations for the 1997 rematch, Khodarkovsky[35] and Shamkovich (1997, p. 180) report: "Gary and his team took up residence in the Plaza hotel and in his suite were some special companions: three computers!"[36] These machines were used in-between games to analyze *Deep(er) Blue's* play and thus inform Kasparov's stratagems for dealing with it.

But the entanglement of human and machine in Kasparov's play can perhaps be best illustrated with reference to the second game of the 1997 rematch tournament in which Kasparov resigned on the point of his 46th move apparently seeing his position as hopeless. In the immediate

aftermath there was much praise for the superior play of *Deeper Blue*, but later analysis involving various grandmasters and their own chess computers revealed a more complex situation. As it transpired, *Deeper Blue's* 46th move was a mistake in that it could have let Kasparov secure a draw by moving to a situation of perpetual check. The fact that Kasparov—uncharacteristically—failed to see this possibility, hence his premature resignation, has been attributed to the fact that he presumed that the computational power of *Deeper Blue*, which involved the ability to look ahead at many layers of possible moves and which underpinned its tactical strength, had analyzed the situation thoroughly (see Khodarkovsky & Shamkovich, 1997, pp. 193–206; King, 1997, p. 73). Thus, we might say that while Kasparov tried to play in a way that would exploit the weaknesses of computer chess—for instance, in terms of strategy, and the relative positioning of pieces—he also informed his own decisions by the computer's much trumpeted computational powers and ability to analyze many millions of moves per second; in this instance, we might suggest that his own play was, so to speak, crucially shaped by expectations concerning the "agency of the machine."

It is therefore worth revisiting the argument made by De Firmian (1999) and others to the effect that computer opponents have tended to elicit a different kind of play from the human champion(s). It is not merely that Kasparov or for that matter his successor(s) in the role adapt their play to neutralize the perceived strengths and exploit the weaknesses of their machine adversaries. Rather, something more may have been going on. Commenting on the inability of Kasparov and of his successor to the world title, Vladimir Kramnik,[37] to manage anything better than draws in their respective (post-*Deep Blue*) "man versus machine" tournaments against what most commentators consider inferior chess programs, Feng-Hsiung Hsu (2002, p. 275) questions whether

> the two computers [were] really playing at Vladimir or Garry's level? The match scores said so. Do I believe that? Yes and no. Vladimir and Garry were playing at the computers' level but the computers were not playing at the level that Vladimir and Garry are capable of.

The "human champions" were playing at the level of their computer opponents rather than vice versa. In particular, the human champions appeared not to be making full use of their main advantage—i.e., chess knowledge. (Recall, for instance, De Firmian's 1999 comments cited earlier, or Kasparov's resignation instead of forcing a draw in the second game of the 1997 tournament—not the reaction one would expect from a grandmaster). "Why couldn't the top two humans bring their chess knowledge to bear in [those games they lost]?" (Hsu, 2002, p. 276). His hunch is that "they [Kramnik and Kasparov] were overwhelmed by the pressure *not to lose* [to a computer]" (ibid, emphasis in original). They were in other words brought down not by the calculative powers of their opponents but under the weight of their own (self-assumed) symbolic role.

FIG. 2. Vladimir Kramnik vs. Deep Fritz (2006).[38]

DISCUSSION

As the stubborn persistence of the "(hu)man vs. machine" frame reminds us (e.g., Fig. 2), chess contests have long functioned as allegories for Occidental anxieties concerning the status of the human subject. It is therefore hardly surprising that human chess champions have refused to accept their defeat by computer programs with equanimity and have been unable to resist scratching that particular scab again and again. Immediately after his 1997 defeat, Kasparov demanded a rematch with *Deep(er) Blue*, this time offering to compete with it for the World Championship (!), a rematch that for whatever reasons never materialized (e.g., Hsu, 2002, pp. 270–271). *Deep(er) Blue* has now reportedly been dismantled, taking its secrets with it (Hartson, 1997).[39] Its short but glorious career, IBM claimed, was but a prelude to the application of its technology in other areas of expertise. Those who had their suspicions regarding its 1997 success will now have to go with their questions left unanswered. But were they the right questions to start with?

Lucy Suchman (2007, p. 1) has argued that questions of agency in computational artefacts beg another

question, namely of how the entities in question come to be framed/configured as human or artificial "prior to our analyses." To answer *this* question we need to look again at our ways of sorting out what is human from what is not. The late Jacques Derrida (1976) used the term "supplement" as shorthand for that "inessential extra" that needs to be added in order to complete and enhance the presence of something which already claims to be complete and self-sufficient. But clearly, Derrida argues, anything that needs a supplement cannot be already complete on its own. Following this line of argument the "human" and the "machine" contestants of the Kasparov versus *Deep(er) Blue* contests can be said to be deeply involved with one another in a relationship of mutual (in)determination and supplementarity. "Human" and "machine" appear as, or are claimed to be, wholly present and self-sufficient, and to need the other merely as an appendage, an afterthought (e.g., see Dennett, 1996, quoted earlier in this article). However, upon more systematic (re)examination, what was described as external and inessential often turns out to be compensating for an essential lack, to be filling in a hole, in the original. In a not dissimilar move, Bruno Latour (1993, p. 78) has argued that while the world is made up of "hybrid" entities, Occidental accounts of agency tend to break such hybrids apart in order to identify what came from the subject (the human) and what came from the object (the technology). In this account, we *start* with hybrids and try to obtain the "human" and the "technical" out of them rather than vice versa. Agency is seen to reside either in the machine or in the people behind the machine. In Latourian terms, however, both are products of processes of purification. As he notes in *A Dialog in Honor of HAL* (Latour & Powers, 1998):

> The idea of a test matching a naked, isolated intelligent human against an isolated naked automated machine seems to me as unrealistic... Things and people are too much intertwined to be partitioned before the test begins, especially to capture this most heavily equipped of all faculties: intelligence.

Human versus machine contests are thus, according to Latour, little more than shadowboxing. The machines—or for that matter the humans—that battle each other on these occasions are in this view creatures of legend, products of our culture-specific forms of storytelling. If so, what is it that compels us to tell such stories? Furthermore, what is it that incites us to make these stories, as it were, "come true" through elaborate staging(s)?

CONCLUDING REMARKS

Sherry Turkle (1984) has famously described the digital computer as a "Second Self." Such a description carries a heavy symbolic load. Among other things, it evokes an image of the computer as a creature of Occidental[40] modernity's claimed "demiurgic ambition to exorcise the natural substance of a thing in order to substitute a synthetic one." (Baudrillard, 1983, pp. 88–89). Here again HAL, the mythological intelligent machine by reference to which the story of the future of AI is often narrated (e.g., Stork, 1997; Vendy and Nofz, 1999; Bloomfield, 2003)—and on whose "birthday" the human dominance of the world of chess is said to have ended—is illustrative. For what is HAL's crime but the Original Sin? Moderns, having created thinking machines in their own image, immediately expect that these machines will—just like they themselves did—attempt to usurp the powers of their creator. Thus Hans Moravec (1988, p. 1) speculates about a "postbiological" future "in which the human race has been swept away ... usurped by its own artificial progeny." It is perhaps paradoxical but not unexpected that AI, the enterprise that is said to epitomize the workings of reason, is at the same time so heavily mythologized (Turney, 1998).

Anthropologists such as Nancy Munn (1986), Brian Pfaffenberger (1995), and others have drawn attention to the ways in which technological artifacts are more than merely functional objects but may also serve to constitute occasions where the categories and distinctions that give meaning to social life are enacted. In her account of computers as "evocative objects" Turkle (1984, p. 31) echoes this point when she argues that objects "[o]n the lines between categories ... draw attention to how we have drawn the lines. Sometimes ... they incite us to reaffirm the lines, sometimes to call them into question, simulating different distinctions." Turkle's main focus is on the social psychology of human–computer interaction. Our own focus in this article has been rather different. We have argued here that to the extent to which computational artefacts *do* come to play such a role, they do not do so, as it were, "naturally," by virtue of their inherent qualities but as part of specific social performances. We could therefore "read" human versus "intelligent" machine contests, from Kempelen's Turk to IBM's *Deep(er) Blue*, as events where some of the central philosophical and moral conflicts of Occidental modernity were/are *dramatized*: self vs. other; identity vs. difference; free will vs. determinism; subject vs. object; nature vs. artifice, and so forth.

Lucy Suchman (2007) makes a relevant point in relating her encounters with MIT's robots Cog and Kismet, artifacts we might say of the "bottom-up" (i.e., behavioural and embodied) approach to AI as opposed to that of abstract symbol manipulation dating from the 1950s (Bloomfield & Vurdubakis, 1997).[41] In it, she notes that the ability of these artifacts to act out the role of what we might call a (potential) "Second Self," was crucially dependent upon specific practices of framing. These "framings" served to locate the various human labors, relationships, and technologies upon which their performance routinely relied, outside the picture. In the case of the

chess tournaments under discussion here it is notable that many of the media representations routinely cropped out the IBM operators.[42] Our own analysis of *Deep(er) Blue*'s successes and failures has suggested a relational view of "intelligence": that is to say "intelligence" not as a property located "inside" the machine "itself" but as crucially dependent on the performative capabilities of its "operators." We have therefore endeavored to remain attentive to the "missing supplement," that which is left out by the "[hu]man versus machine" framing that has dominated narrations of the Kasparov–*Deep Blue* (and subsequent) tournaments. Even this dominant media frame, we have argued, affords glimpses of a less brightly lit "backstage" and of the shifting human–technical assemblages that make possible a "front stage" where "man versus machine" drama is performed before the eyes of a watching world.

NOTES

1. This was the original title of Warwick's (1997) book *In the Mind of the Machine*.

2. King Canute's fabled attempt to turn the tide is usually (and unfairly) cited as an example of out of control megalomania. In fact the king's purpose was to give a lesson in humility to his sycophantic courtiers. It is said that after that incident Canute never again wore his crown but hung it instead in Winchester Cathedral.

3. In one of Asimov's short stories (*That Thou Art Mindful of Him*) intelligent robots, designed to serve humanity, have become so advanced that they come to the conclusion that they fit the definition of the "human" much better than their creators and thus need to serve no one but themselves (Asimov, 1976).

4. Kurzweil's framing of the past and future development of AI in anthropomorphic terms which suggests both replication of, and competition with, human beings is far from unique. Rather it is a standard feature of the "literary enterprise of AI." For instance, another technological timeline is offered by researchers at British Telecommunications plc. It includes: "AI Entity gains degree 2013–217. . . AI Entity gains PhD 2020s. . . Robots mentally and physically superior to humans 2030s".http://www.btplc.com/Innovation/News/timeline/Technology Timeline.pdf (accessed October 30, 2007).

5. For example, see Latour and Powers (1998). AI narratives in both fiction and nonfiction often have recourse to biblical imagery, from Multivac the computer in Asimov's *The Last Question* (Asimov, 1986), to Wintermute in Gibson's (1984) *Neuromancer,* and from Moravec's (1988) *Mind Children*, to Warwick's (1998) *In the Mind of the Machine* (see also Davis, 1999).

6. For a fuller discussion see Bloomfield (2003).

7. This article also appears under the title "Swift and Slashing, Computer Topples Kasparov," *New York Times*, May 12, 1997. http://query.nytimes.com/gst/fullpage.html?res=9903E5D91039F931A25756C0A961958260 (accessed November 1, 2007).

8. We use the term "Occidental" here to acknowledge the fact that the view of machines—and of "intelligent machines" in particular—in other (say, Japanese or Korean) cultures is often quite different.

9. The notion of a "Modern Prometheus" of course became the theme of Mary Shelley's (1992, orig, 1818) *Frankenstein*.

10. The apparatus was presented to the public as a puzzle, a challenge to identify the location of the automaton's intelligence. This is how Edgar Allan Poe (1855/1982: 425–426) describes the prelude to a performance in Richmond, Virginia:

> "Maelzel now informs the company that he will disclose to their view the mechanism of the machine . . . . and throws the cupboard fully open to the inspection of all present. Its whole interior is apparently filled with wheels, pinions, levers, and other machinery, crowded very closely together, ... he goes now round to the back of the box, and raising the drapery of the figure, opens another door situated precisely in the rear of the one first opened. Holding a lighted candle at this door, and shifting the position of the whole machine repeatedly at the same time, a bright light is thrown entirely through the cupboard, which is now clearly seen to be full, completely full, of machinery."

11. Legends that quickly became part of the mystique of the automaton and related in stories and plays such as *La Czarine* (1968) by Adenis and Gastineau (Chapuis & Droz, 1958, p. 365).

12. In fact, the interest in chess and computers predates the birth of AI in 1956. For instance, it was discussed earlier by Wiener (1950), who saw the domain of chess as but a forerunner of applications in other areas requiring complex decision making. But as things have turned out, it isn't the most esoteric areas of problem solving (chess, analytical mathematical problems etc.) that have proved most recalcitrant to AI work but rather the most mundane features of everyday intelligence such as common sense knowledge.

13. Thus drawing "an analogy with geneticists' use of that fruit fly."

14. As Stork (n.d.) notes in an essay on the IBM website, in the Arthur C. Clarke (1968) novel of the film, "HAL is programmed to lose 50% of the time—to keep things interesting for the astronauts." Whether it would have that effect is debatable since it would have changed chess from a game of skill to a game of chance. Interestingly, "Kubrick originally filmed the 'chess scene' with a five-in-a-row board game called pentominoes but chose not to use it, believing that viewers would better appreciate the difficulties involved in a chess game" (Campbell, 1997).

15. A bloodless mimesis of the conflict of war, as usefully noted by one of the reviewers for this article.

16. We thank one of the reviewers for this point.

17. For a complete chronology of these "human–machine" encounters up to, and including, the 1996 Kasparov–*Deep Blue* tournament see Newborn (1997).

18. For its achievement, *MacHack* became an honorary member of the U.S. Chess Federation (Boden, 1977, p. 353).

19. As with all legendary events, different sources offer alternative dates, for instance, 1967, for his encounter; 1968 is the date given by Dreyfus (Dreyfus & Dreyfus, 1986).

20. For a discussion of the notion of autonomous technology in political thought see Winner (1985).

21. Malcolm Pein, *London Chess Centre*, covering Game 5 of the 1997 rematch for the IBM web site. http://researchweb.watson.ibm.com/deepblue/games/game5/html/c.2.html (accessed October 30, 2007).

22. At the time this program was available in the high street at a cost of less than £150 and ran efficiently on a relatively modest machine

(Jones, 1994), it was based on Richard Lang's program Pentium Chess Genius (Newborn, 1997).

23. That is, each "player" was allowed only 25 minutes per game to complete all their moves.

24. This statement was contained on the webpage of the official IBM Internet site specially devoted to covering the tournament. www.chess.ibm.com (accessed February 16, 1996).

25. The IBM team of scientists took turns facing Kasparov.

26. And in another intriguing parallel, the 2006 world chess championship between Veselin Topalov and Vladimir Kramnik was marred by the allegation that the latter used over-frequent visits to the toilet in order to secretly consult a chess computer (Barden, 2006).

27. Hsu (2002), of the IBM team, discusses the fixing of bugs within the software in between games. Of course, such attempts to fix the computer program could work to Kasparov's advantage insofar as repairs in one area might merely serve to open up weaknesses elsewhere.

28. http://researchweb.watson.ibm.com/deepblue/meet/html/d.html (accessed October 30, 2007).

29. http://researchweb.watson.ibm.com/deepblue/watch/html/c.8.html (accessed October 30, 2007).

30. www.sciam.com/explorations/042197/chess/042197blueinter.html (accessed October 30, 2007).

31. During an interview with John Horgan (1996) of *Scientific American* following the 1996 match, one of the IBM team—Joseph Hoane—complained about the "human error" during the draw in game 5 when the "computer's managers" rejected Kasparov's draw offer.http://www.sciam.com/article.cfm?articleID=00058BE2-DD78-1CD9-B4A8809EC588EEDF&sc=I100322 (accessed October 30, 2007).

32. http://www.research.ibm.com/deepblue/home/may06/story_2.html (accessed October 30, 2007).

33. http://www.research.ibm.com/deepblue/watch/html/c.10.6.html (accessed October 30, 2007).

34. http://www.research.ibm.com/deepblue/home/may03/story_3.html (accessed October 30, 2007).

35. Khodarkovsky, a friend of Kasparov, was also a member of his team.

36. Of course "Kasparov" is also a brand of chess-playing machines, of which over 100,000 had been sold by the time of the first Kasparov–Deep Blue confrontation (Krauthammer, 1996).

37. Kramnik donned the mantle of humanity's defender and in 2001 agreed to take on the reigning computer chess champion *Deep Fritz*, arguing that "It will be hard, but I would like to prove that humans are still worth something" (cited in *The Sunday Telegraph*, December 23, 2001, p. 14). After a series of inconclusive tournaments Kramnik finally lost to *Deep Fritz* in 2006 (Fig. 2).

38. Courtesy of the RAG Group, sponsors of the Kramnik–*Deep Fritz* encounter.

39. Only a weaker version, Deep Blue Junior, was to continue the challenge at chess (Hartson, 1997).

40. See note 6.

41. Developed at MIT's AI Laboratory, Cog is a human-like head and torso built to "approximate the sensory and motor dynamics of a human body" and learn through interaction with humans (http://www.ai.mit.edu/projects/humanoid-robotics-group/cog/overview.html). Also built to explore social interactions, Kismet is a robot developed to emulate interactions with a "human caregiver" through, for instance, "gaze direction, facial expression, body posture, and vocal babbles" in a manner "reminiscent of parent-infant exchanges" (http://www.ai.mit.edu/projects/sociable/overview.html). See also note 4.

42. For example, in the photograph accompanying *The Guardian* article by Tran (1996b). In some accounts the presence of the IBM operator was very much that of an inessential extra. In an earlier "human versus machine" encounter, on this occasion between Kasparov and *Deep Thought*, Leithauser (1990), writing in *The New York Times*, referred to the operator role as "largely secretarial."

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