The Thinker's Game:
Decoding the Chess Universe

Melvin Chen

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Acknowledgements

Try to exclude the possibility of suffering which the order of nature and the existence of free-wills involve, and you find that you have excluded life itself.

— C. S. Lewis

This book on chess was written during a period of intense personal turmoil. It has been argued that suffering confers no privileges; it is what one does with suffering that matters. I would beg humble leave to differ: suffering confers wisdom and clarity of judgment. It throws into stark relief the things that truly matter in life. Tough though the circumstances have been, the raw material of my experiences has been transmuted into a booklength attempt to decode the chess universe. Several individuals have played an important role in the transmutation process and it would be remiss ofme to fail to acknowledge them. Barbora, you remain a creative muse and a constant source of inspiration: not a single word of this book would have been written without you. Henrik, as you have already received your ID from the Singapore Chess Federation and will soon compete in chess, it is my hope that you will find much of interest and value in the pages that follow. Mum, dad, and Jo, I am grateful for your support, patience, and encouragement. It is heartening to know that I can always count on you. Dan, you have been an excellent publisher and working alongside you in the publication process has been an honour and a privilege. Judit and Árpád, thank you for your generosity, time, and kindness. I hope to take you up on your offer of tea in Hungary at some point in the future. Geri, you have been such a pillar of strength and hope that I consider you more as a confidante and friend than a colleague now. Jesvin, May, Uganda, Chenyang, K. K., Peng Hwa, and Christina, I continue to cherish the tact, respect, and empathy that you have shown me at various junctures throughout my ordeal.

Chapter 1

Introduction

Chess is a sea in which a gnat may drink
and an elephant may bathe.

— An old chess proverb

Few games have held sway out over the imagination of human civilization in the manner that chess has done. From its humble origins as chaturanga in the Indus civilization, chess has survived various bans imposed on it by the Abbasid caliph al-Mahdī (780), the Eastern Orthodox Church (1093), the rabbi Maimonides (1195), King Henry III of England (1260), King Charles V of France (1375), and Tsar Alexei of Russia (1649), the Ayatollah Khomeini of Iran (1981), and Mullah Mohammad Omar of the Taliban in Afghanistan (1997). Part of the enduring appeal of chess concerns an aware-ness of the rich tapestry of its history, which we shall cover in Chapter 2. Part of its enduring appeal concerns how chess is at once both relatively easy to pick up and difficult to master.

This book is written for beginners who are interested in the game and would like to learn more about its various aspects. It covers the technical aspects of chess: the use of algebraic notation (Chapter 3), chess evaluation (Chapter 4), the opening phase (Chapter 5), the middle game (Chapter 6), the endgame (Chapter 7), and the chess rating system (Chapter 8). It introduces a number of chess problems, formulated with a chess board and chess pieces and

presupposing a working knowledge of chess (Chapter 9). It offers an account of variants of chess such as Fischer random chess (Chapter 10). It also covers the cultural aspects of chess: its history (Chapter 2) and status as an immortal game that might enable it to play a role in the search for extraterrestrial intelligence (Chapter 11). Wherever possible, chess diagrams are provided to help chess beginners make sense of certain points about chess. Algebraic notation will also guide them in understanding certain chess-based lines of reasoning. Whenever you are ready, let us begin this odyssey of chess.

Chapter 2

A Brief History of Chess

2.1 Petteia, chaturanga, and shatranj

Historically chess must be classed
as a game of war.

— H. J. R. Murray

A chess beginner should acquaint herself not only with the standard notation, rules of chess, principles for playing good chess, method for evaluating chess moves, chess theory, and book moves, but also the history of the game. Chess is a board game and board games with chips were played in Assyria, Mesopotamia, and Egypt as early as the 3rd and 4th millennium

B.C.E. Chess is a descendant of the Indian game of chaturanga, played in the 7th century C.E.: both chess and chaturanga share a similar arrange-ment and method (Murray, 1913). Chaturanga (literally: having four limbs or parts) refers to the four divisions of a traditional Indian army: the elephantry, the chariotry, the cavalry, and the infantry. These four divisions of the army were

faced by Alexander the Great in his Battle of Hydaspes (326 B.C.E.) against King Porus, an ancient Indian king, with King Porus — himself fighting on the royal elephant — unsuccessfully staking everything on his elephantry to disrupt the Macedonian cavalry and terrify the infantry (Whitby, 2001).[1]

Ever since the Battle of Hydaspes and the Indian campaign of Alexan der the Great, a Hellenistic element has been present in India. It should not therefore surprise us if the history of chaturanga includes an ancient Greek element. In the *Phaedrus* (274d), Thoth, an Egyptian deity, is invoked as the inventor of writing, arithmetic, numeracy, geometry, astronomy, and board games (petteia) and dice games (kubeia) (Plato, 360 B.C.E./1952). In Book II (374c) of the *Republic*, it is suggested that being skilful at playing pet teia or kubeia requires practice and devotion from an early age (Plato, 360 B.C.E./2008). Certain details about petteia (exact number of pieces, exact rules of the game, and so on) are lost to us, although we do know that it is a two-player board game of strategy in which the aim is to capture the opponent's pieces. The method of capture consists of surrounding an enemy piece on both sides by two of your own pieces. Given the similarities between petteia pieces and chess pawns in how they move one square forward diagonally to capture enemy pieces (Fig. 2.1), Samsin (2002) has speculated that the pawn's powers of capture in chess may have evolved from petteia. Averbakh (2012) has proposed an even grander six-stage argument for the Hellenistic development of chaturanga:

Stage 1: A race game with dice on an 8 x 8 board, similar to the Greek kubeia, appears;

Stage 2: The game pieces are replaced with miniature chariots;

Stage 3: As chariots battle each other, the game transforms from a race game to a game of strategy;

Stage 4: Previously named ashtāpada after its board size (8 8), the game receives a new name: chaturanga;

1 We shall have more to say about the connection between war and chess in our discussion of middle game tactics and strategy in § 6.4.

Stage 5: As a game for four players becomes a game for two players, a new rule emerges: when the king gets taken, the game is lost;

Stage 6: Following the Greek petteia, dice get discarded.

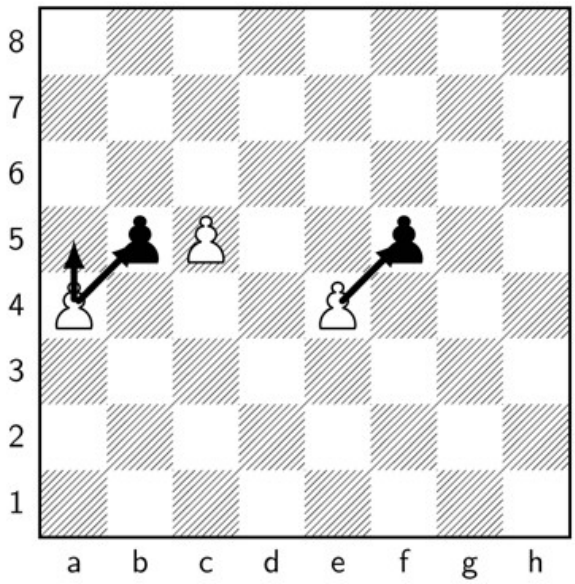

Figure 2.1: Similarities between petteia pieces (left and simulated on a chess board) and chess pawns (right) in the capture of enemy pieces

Other descendants of chaturanga include 象棋 or xiangqi (China), 将棋 or shōgi (Japan), sittuyin (Myanmar), makruk (Thailand), and chator (Malay archipelago). The ancestor of chess, chaturanga boasts pieces that reflect the four divisions of the army. They include the king (raja), minister (mantri), chariot (ratha), elephant (gaja), horse (aśva), and infantry (padàti). There is a sense in which chaturanga may be regarded as part of a long line of military simulations and models of warfare (Smith, 1998). The *Mahābhārata* and the *Ramayana* are the two great Sanskrit epics of ancient India, although neither epic refers to the game of chaturanga (Bhatta, 2003). While the *Ramayana* is replete with references to 'chaturanga', the term is used to allude to the four divisions of an army rather than the game itself. In addition, while a game is mentioned in the *Mahābhārata,* it is not chaturanga but rather a game similar to dice-play (akṣarakrīḍā). The *Mahābhārata* does make reference to a battle formation known as the akshauhini, comprising 21,870 chariots,

21,870 elephants, 65,610 horses, and 109,350 infantry. The ratio for the akshauhini works out to be 1 chariot: 1 elephant: 3 cavalry: 5 infantry.

The earliest known reference to chaturanga may be traced to the Indian poet Bāṇa's *Harṣacaritra* in the 7th century C.E., although the roots of the game of chaturanga may extend thousands of years back to the Indus civilization. Like chess, chaturanga is played on an 8 × 8 board known as an ashtāpada, although the colours of the squares on the ashtāpada board donot alternate as they might on a chess board.[2] The goal of chaturanga is to win the game by any one of the following methods:

Method 1:
Positioning the board such that the enemy king is threatened and unable to avoid capture (similar to a checkmate in chess; see § 3.4);

Method 2:
Capturing all the enemy's pieces, without the enemy being able to do the same in the next move;

Method 3:
Positioning the board such that you are not able to move without placing your king under threat (similar to a stalemate in chess, except that a stalemate results in a draw rather than a win in chess; see § 3.4).

The king (raja) moves one square in any direction to an unthreatened position, without any powers of castling (§ 3.4). The minister (mantri) moves one square in a diagonal direction. The chariot (ratha) moves any number of squares vertically and horizontally like a rook. The elephant (gaja) moves two squares in a diagonal direction. The horse (aśva) moves as a knight in chess does, in an L-shaped manner. The infantry (padàti) moves as a regular pawn in chess does, although it can neither move two squares vertically on the first move (§ 3.2) nor capture other pieces *en passant* (Fig. 2.3). According to one myth, the Indian Brahmin mathematician Sissa was supposed to have invented the game of chaturanga. When asked by the king about what reward he wanted for this fine invention, Sissa presented the king with the wheat and chess board problem. According to this problem, if a chess board were to have wheat placed on each of its 64 squares such that one grain is

2 The ashtāpada may be contrasted with the daśapada, a larger 10 × 10 board.

placed on the first square, two on the second, four on the third, and so on, how many grains of wheat would be on the chessboard at the end? This would be the amount of wheat demanded by Sissa. The sum of grains works out to be $1 + 2 + 4 + \ldots$ or $2^{64} - 1$. This would be 18,446,744,073,709,551,615 (more than 18 quintillion or 1.8×10^{19}) grains of wheat, several thousand times more than the annual world production of wheat.

Chaturanga was later introduced to central Asia. To be precise, chaturanga first made its way from India to Iran, where the Persian high society learnt how to play the game and chess was enlisted as part of a method for raising princes. Following the Arab conquest of Iran (632 –654), Arab Muslims became acquainted with chess. As Arab Muslims lacked the 'ch' and 'ng' consonant sounds in their speech, they turned 'chaturanga' into 'shatranj', just as they made the game their own. The king (raja) in chaturanga became the shāh (from which we derive the term 'checkmate') in shatranj, the minister (mantri) became the counselor (ferz), the chariot (ratha) became the rukh (from which we derive the term 'rook'), the elephant (gaja) became the pīl, the horse (aśva) became the asb or faras, and the infantry (padàti) became the sarbaz. The king in chess would evolve from the raja or shāh, the queen from the mantri or ferz (minister), the rook from the ratha or rukh (chariot), the bishop from the gaja or pīl (elephant), the knight from the aśva or asb (horse), and the pawn from the padàti or sarbaz (infantry). The powers of movement for the pawns and pieces in chess (king, queen, rook, bishop, knight, pawn) will be given in § 3.2. As a result of the Quran's banon images of humans and animals, the game pieces had to be changed to abstract shapes (Averbakh, 2012).

2.2 Medieval invention and evolution

The high and late medieval period (1000 –1500) is marked by invention and evolution.[3] First and foremost, there is a long history of prohibitions being instituted against chess and its variants that may be traced to the medieval period and earlier. In the *Brahmajāla Sutta*, Siddhartha Gautama (the Buddha) is described as abstaining from both chess and its variants, played on either

3 The high medieval period lasted from 1000 –1300, while the late medieval period lasted from 1300 –1500.

an ashtāpada (8 × 8) or a daśapada (10 × 10) (§ 2.1). We have already learnt how the Quran's ban on images of humans and animals resulted in the game pieces of shatranj having to be changed to abstract shapes instead (§ 2.1). Fig. 2.2 provides us with a timeline of these bans, interdictions, and prohibitions on chess. Necessity is the mother of invention. The need to play chess, even under Bishop Guy of Paris's threat to excommunicate any priest caught playing chess in 1125, resulted in the medieval invention of the foldable chess board in the 12th century. An ingenious priest came up with idea of the foldable chess board, designed to look deceptively like two books lying together.

The medieval period witnessed two types of pieces receiving heightened-powers of movement. Recall how the queen would evolve from the mantri or ferz (minister), while the bishop would evolve from the gaja or pīl (elephant) (§ 2.1). Furthermore, recall how the minister moves one square in a diagonal direction, while the elephant moves two squares in a diagonal direction. This does not resemble the powers of movement of the queen and the bishop in chess, which will be described in § 3.2. In the late 1400s, changes were instituted to increase the powers of movement of the bishop and the queen. According to one theory, Queen Isabella of Castile's reign was contemporary with the increase in power of the chess queen. This theory, though fascinating, of course fails to explain why the bishop's powers of movement simultaneously increased.

Furthermore, a set of new rules was invented for pawns. The first new rule allows pawns to move two squares forward vertically instead of one on their first move. The second new rule (known as *en passant*) prevents players from taking advantage of the first rule to sneak past enemy pawns without any consequences. The *en passant* rule was introduced sometime between 1200 –1500, although some sources have specifically stated 1561 as the year of introduction. The en passant rule permits the capture of a pawn by an enemy pawn on the same rank and adjacent file that has just made an initial two-square advance. Consider the board position illustrated in Fig. 2.3. White has two pawns on their home squares, one on a2 and another on b2, while Black has two advancing pawns, one on a5 and another on b4.

We shall have more to say about algebraic notation in the next chapter. For the moment, note that if the a2 pawn decides to skip past the enemy pawn on b4 by moving two squares forward (according to the first new rule), the b4

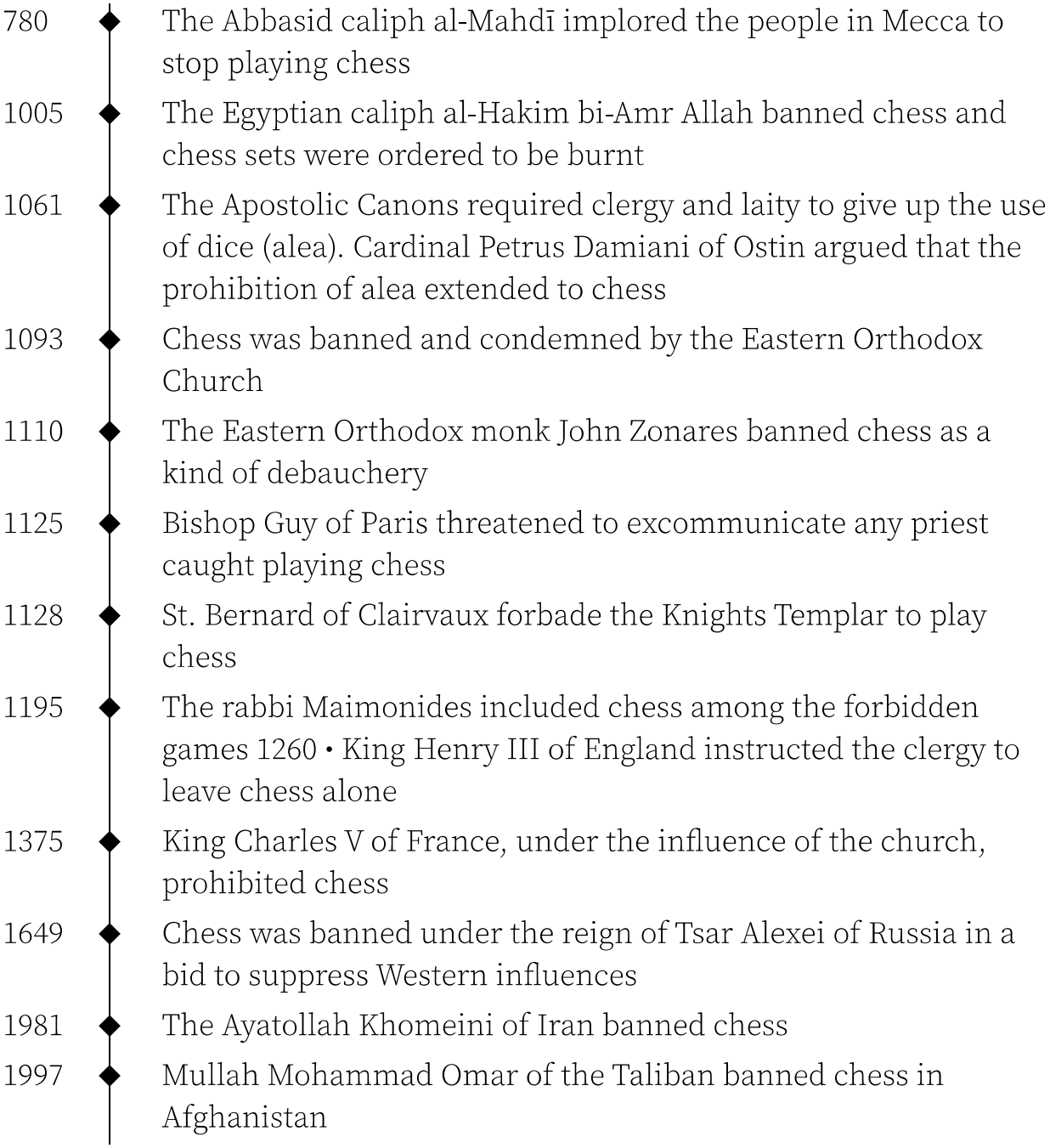

Figure 2.2: Timeline of ban on chess and its variants (Murray, 1913; Shenk, 2011)

enemy pawn can still capture *en passant* the a-file white pawn (according to the second) and move to the a3 square that this captured pawn has passed over.

The rules of chess and the enhanced powers of movement of the bishop and queen were first published in Luis de Lucena's *Repetición de amores e arte de axedrez* in 1497. In another piece of late medieval trivia, the second book printed in the English language was William Caxton's *The Game of Chess* in

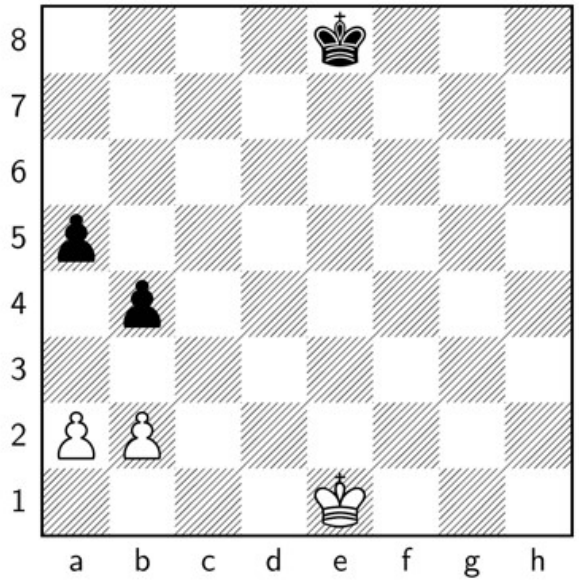

Figure 2.3: The *en passant* rule

1483. Strictly speaking, however, it is not a book about chess. Rather, it relies on the metaphor of chess to depict the relations between aking and the various estates of his kingdom. Nonetheless, it does include the rules of chess, rendering the metaphor more accessible to Caxton's readers. Fig. 2.4 depicts a page from Caxton's *The Game of Chess*.


This chapytre of the fyrſt tractate ſheWyth Who fond first the playe of the Cheſſe. Capitulo ij

His playe fonde a phyloſopher of thoxyent Whyche Was named in caldee Eyerſes or in greke philemetor Which is as moche to ſay in engliſſh as he that louyth Juſtyce and meſure / And this philoſopher Was renomed gretly among the grekes and them of Athenes Whyche Were good clerkys and phyloſophers alſo renomed of their connyng / This philoſopher Was ſo Juſt and treWe that he had leuer dye / than to lyue long and be a fals flatterer With the ſayd kyng / For Whan he behelde the foul & ſynful lyf of the kyng · And that no man durſt blame hym

Figure 2.4: A page from William Caxton's *The Game of Chess* in 1483. The image has been taken from Wikimedia Commons

2.3 1500s–late 1800s

If Greek, Indian, and Arab influences could be identified in the early history of chess (§ 2.1) and the high and late medieval period was characterized by invention and evolution in the face of prohibitions and interdictions (§ 2.2), then the 1500s – late 1800s was marked by the advent of chess

theory, a further clarification of the rules of chess, and the Romantic style of chess. Rodrigo Ruy López de Segura, a Spanish chess player and Catholic priest, wrote one of the first treatises on modern chess in 1561, entitled *Libro de la invención liberal y arte del juego del axedrez*.[4] Ruy López made significant contributions to chess opening theory, including the analysis of the chess opening that bears his name: the Ruy Lopez opening (more on which in § 5.5). François-André Danican Philidor is another example of a great chess thinker. Philidor was a French composer and chess player and his *Analyse du jeu des Échecs,* first published in 1749, is widely considered to be an important chess manual. Besides his advocacy in favour of the Philidor defence that bears his name (§ 5.5), Philidor is known for his advice concerning the role of pawns in a game of chess: pawns are the soul of chess.

The powers of movement of the king and the rook were enhanced during this period with the introduction of castling. The current version of castling, combining the moves of the king and the rook into a single move, may be traced to the 1600s. It is the only move in chess where two pieces (a king and a rook) are moved at once. We shall have more to say about this move in § 3.4. This special move has its historical roots in the king's leap, which allows the king to move either like a knight or two squares on its first move.Like castling, the king's leap was employed to ensure the safety of the king. The introduction of this new move may be regarded as a response to the enhanced powers of movement of the queen and bishop (§ 2.2), which made the king a bit too easy to capture.

The rule concerning pawn promotion offers another instance of the rules of chess being clarified during this period. Pawn promotion, which occurs when a pawn reaches the last or promotion rank of the board, is already part of chaturanga, the ancestor of chess. However, certain accounts indicate that the padàti (the predecessor of the pawn) could only promote to a mantri (the predecessor of the queen). Until its standardization, different versions of the rule concerning pawn promotion existed. According to one version, a pawn could only be promoted to a piece that had already been captured. This implies that a player cannot end up with more than one queen or more than two knights, two bishops, or two rooks. If no pieces had been captured, then

4 The Moors of North Africa rendered 'shatranj' as 'shaterej', giving rise to the Spanish 'axedrez' and 'ajedrez'.

the pawn could remain suspended on its promotion square until a piece had been captured. According to another version, a pawn could only be promoted to a queen. The modern and standard version of the rule, originating from the British Chess Association, allows a pawn on the promotion square to be promoted to any piece except a king. This rule is endorsed by Steinitz (1889), for whom a pawn, on reaching the promotion square, may be exchanged for either a queen or any other piece the player may select.

Another key invention in chess may be traced to this period: the Staunton chess set. In 1849, Jaques of London, a manufacturer of games and toys, introduced a new style of chess pieces designed by the journalist Nathaniel Cooke. These pieces were endorsed by Howard Staunton, an English chess master, and came to be known as Staunton pieces. The Staunton chess set has since become the standard style of chess pieces, recommended for use by the FIDE (*Fédération Internationale des Échecs*) or international chess federation. Last but not least, the 18th century was characterized by a style of chess known as Romantic chess, although it would wane in popularity by the second half of the 19th century. The Romantic style of chess emphasizes short-term tactical maneuvres rather than long-term strategic planning.[5] The American chess player Paul Morphy may be regarded as its poster child: his style of play is filled with swashbuckling attacking tactics and ideas. During his tour of Europe in 1858–59, Morphy trounced every major chess player across the European continent except Staunton, who was then already past his prime and declined Morphy's challenge.

5 We shall develop the distinction between tactics and strategy in Chapter 6 on the middle game, since tactics and strategy predominate in this particular phase of the chess game.

2.4 Late 1800s–present

1846	First issue of *Deutsche Schachzeitung*, a German chess magazine that was the world's oldest chess journal until it ceased publication in 1988
1851	First international chess tournament
1867	Introduction of mechanical game clocks in tournament play
1877	Establishment of the German Chess Federation or *Deutscher Schachbund*
1881	First issue of *British Chess Magazine*, the world's oldest chess journal in continuous publication
1885	First issue of *International Chess Magazine*. It ceased publication in 1891
1886	First world chess championship
1904	Establishment of the British Chess Federation 1924 • Establishment of FIDE
1924	Establishment of the U.S.S.R. Chess Federation 1927 • First chess olympiad
1927	First women's world chess championship 1939 • Establishment of the U.S. Chess Federation
1946	First issue of *Chess Life*, the official magazine of the U.S. Chess Federation
1950	Introduction of grandmaster (GM) and international master (IM) lifetime titles by FIDE to indicate chess achievement
1951	First world junior chess championship
1951	Establishment of the International Correspondence Chess Federation (ICCF)
1984	Establishment of the World Chess Hall of Fame 1985 • Establishment of the European Chess Union 1986 • Establishment of the Grandmasters Association 2000 • First FIDE World Cup
2003	Establishment of the Association of Chess Professionals 2004 • Establishment of the English Chess Federation

Figure 2.5: Timeline of watershed events for chess institutions

The 19th and early 20th centuries were marked by the institutionalization of chess, while the second half of the 20th century and early part of the 21st have witnessed both Soviet and Russian dominance at the world chess championship level and the rise of the machines. The second half of the 19th century saw the commencement of modern chess tournament play: the first international chess tournament was held in London in 1851 (conceived and organized by Staunton) and the first world chess championship was held in the United States in 1886 (won by William Steinitz). The era of Romantic chess was brought resoundingly to an end by Steinitz, whose emphasis on the closed game (§ 5.2) and positional play and world championship-winning turn would usher in the classical or modern era of chess.[6]

The 20th century witnessed the establishment of FIDE in 1924, the first chess olympiad in 1927, and the first women's world chess championship in 1927. The 20th and early 21st centuries were characterized by Soviet and Russian dominance at the world chess championship level, with players from the Soviet Union and Russia holding the world chess championship title almost exclusively from 1927–2006. Fig. 2.5 provides us with the timeline of watershed events for chess institutions during this period.

The second half of the 20th century and early part of the 21st century has been marked by the burgeoning role of the computer: online chess, computer analysis, and supercomputers capable of challenging human world chess champions. Deep Blue, a chess-playing IBM supercomputer, challenged the then-world chess champion Garry Kasparov to two six-game chess matches in 1996 and 1997. Kasparov took the first match by 4-2 in 1996, although Deep Blue won the second match by 31/2 – 21/2 in 1997. Fig. 2.6 contains information about the final scores of each game in both the 1996 match and the 1997 rematch between Kasparov and Deep Blue.

6 It is of historical note that Steinitz never played Morphy, who had retired by the time Steinitz became a prominent chess figure. Classical positional chess emphasizes controlling the centre of the board during the opening, typically with pawns. The popularity of classical chess would last till the 1930s, when hypermodernism came to the fore. We shall have a further occasion to distinguish between classical chess and hypermodern chess in terms of their different approaches to opening theory in § 5.2.

Event	Venue	Player	Score for each game						Final score
1996 match	Philadelphia	Kasparov	0	1	½	½	1	1	4
		Deep Blue	1	0	½	½	0	0	2
1997 rematch	New York	Kasparov	1	0	½	½	½	0	2½
		Deep Blue	0	1	½	½	½	1	3½

Figure 2.6: Scores for the 1996 match and 1997 rematch between Kasparov and Deep Blue

Fig. 2.7 provides us with an image of Deep Blue at the Computer History Museum. Based on IBM's RS/6000 SP2 supercomputer, Deep Blue consisted of 30 processors in two towers. Deep Blue employed a chess evaluation function, minimax search, tablebases, transposition tables, and α–β pruning. We shall discuss about transposition in § 3.3, the evaluation function in § 4.4, the minimax search strategy in § 4.6, possible endgames in Chapter 7, and tablebases or endgame databases in § 7.7. *α–β* pruning refers to a technique that allows bushy game trees (§ 4.6) to be pruned when minimax search is employed.[7]

Figure 2.7: Deep Blue (IBM) at the Computer History Museum. The image has been taken from Wikimedia Commons

The Deep Blue chess chip had four main parts: the move generator, the smart move stack, the evaluation function, and the search control (Fig. 2.8). The move generator can generate capturing, checking, and check evasion moves directly. The smart move stack comprises a regular move stack and a repetition detector: the former is a data structure that allows us to keep track of moves, while the latter detects repeated positions and the possibility that a move

7 Other planks in Deep Blue's approach included (but are not limited to) NegaScout, quiescence search, iterative deepening, multiple levels of parallelism, and powerful hardware (Campbell et al., 2002).

might lead to either repetition or near-repetition.[8] The search control implemented an α–β search. Deep Blue's chess chip had been designed to handle more than 8,000 evaluation features and Deep Blue could calculate 200 million positions per second and up to 30 moves ahead in certain instances.

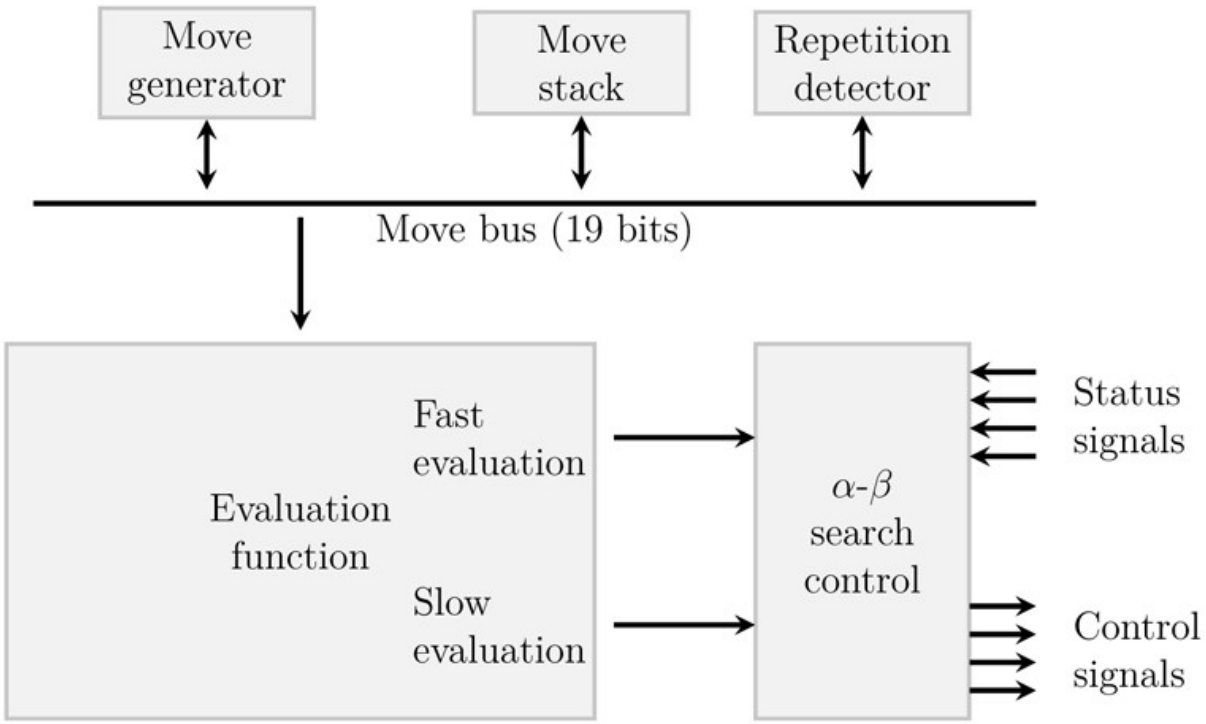

Figure 2.8: Block diagram of the Deep Blue chess chip. Adapted from Hsu (1999, p. 75)

Fig. 2.9 contains a timeline of computer chess milestones. By about 2005, computers were regarded as more powerful at chess-playing than any human being could ever hope to become. The supercomputer Hydra managed to defeat Michael Adams, a British grandmaster then ranked seventh in the world, 5½ – ½. As of February 2024, Stockfish, an open-source chess engine, has an estimated Elo rating of 3634.[9] Even then, AlphaZero (§ 4.4) managed to defeat Stockfish in both a 100-game match in 2017 and a 1,000-game match in 2018. Human chess-playing has improved as a result of a greater reliance on computers and chess engines for analysis, research, and opening theory. While we have certainly come a long way from chaturanga, shatranj, and

8 This allows a player to claim a draw by threefold repetition. According to the threefold repetition rule in chess, a player may claim a draw if the same position occurs three times during the game.

9 We will discuss more about the chess rating system in Chapter 8.

medieval chess, a finer appreciation of the historical narrative of chess will add to the richness, nuance, and texture of our experience of playing and thinking about chess.

Figure 2.9: Timeline of computer chess milestones