

# Chess Theory – Its Structure And Evolution

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## Introduction

When modern chess started to be played, there were several aspects tangled together. Nobody could understand it as a new game. Many elements of the classical chess game were indeed still present, so that it was rather a new way of playing a traditional game, *alla rabbiosa*, in a crazy way, with increased fight elements. In different places, changes in the rules occurred in different times; this is far from surprising if we consider that in addition to the moves of bishop and queen other changes involved castling, *en passant* capture, promotion, and so on.

The same transformation can be differently seen, if considered from nowadays. In reflecting on the history of chess at the time, we have to try and reconstruct its environment as truly as possible. This is however not enough. We have to apply subsequent knowledge too, as now available to us.

Thus let us thus first examine the evolution of chess theory from the present point of view, then add some detail on the progress at the time and its guidelines, and then outline following developments.

## 1 – Retrospective view of chess theory

### *Theory of one game*

A preliminary approach is required for defining any game, with its specific rules. From this point of view, it is not possible to speak of a game of chess. Many versions of chess have been played in various countries in the course of time; many different chess games have been further introduced and new ones continue to be described from day to day.

Every such chess game is in principle a different game, with its own theory, which at most can include common elements with other games.

The chess game that is of interest here is that sometimes called international chess, the modern form of the game, slowly born in Europe by introducing new rules in Islamic chess. As usual, it will commonly be indicated as simply “chess” in what follows.

Based on this game, a world federation, FIDE, has been founded in 1924, dealing with organisation and control of competitions, description and correct interpretations of the game rules, and so on. The easiest way to obtain information about its activity is now by checking the official FIDE web pages.

Some theoretical lines typical of other chess games (e.g. those played for centuries in China, Japan, or Islamic countries) are remarkably older than those found for international chess. From a historical point of view, they can even be more interesting; however, they have not been taken into account in this contribution, which deals with the theory of modern chess, and especially of its opening variants.

### *Chess as object of theory*

Before dealing with the theory of chess, it may be useful to outline how the game of chess itself is considered by the Theory of games. Let us verbatim copy from the “bible” of this subject, the founding work itself, by von Neumann and Morgenstern [1944].

Chess belongs to two-person zero-sum games, with perfect information. Corresponding theoretical expressions show that ‘if the theory of chess were really fully known there would be nothing left to play. The theory would show which of three possibilities [win, tie, loss for first moving player] actually holds, and accordingly the play would be decided before it starts. But our proof, which guarantees the validity of one (and only one) of these three alternatives, gives no practically usable method to determine the true one. This relative, human difficulty necessitates the use of those incomplete, heuristic methods of playing, which constitute “good” Chess; and without it there would be no element of “struggle” or “surprise” in that game.’

Thus, curiously enough, it is only the imperfection of our limited human mind to allow chess to be such an interesting game to play as it is.

### *Imperfect chess theories*

The final theory of chess is not yet ready, but chess players, in spite of their human mental limits, have developed several theories for their

game. The first aim of any such theory is to bypass the slow rate of increasing knowledge by means of actual practice.

Any beginner acquires playing strength by playing, of course. Experience is always a good master, as everybody is ready to acknowledge; however, a chess beginner can improve unexpectedly fast if he knows the theory, or if he just has the chess theoretical works available. Obviously, this theory cannot be the “true” theory of a perfect game. Let us intend as theory the chess knowledge that can be found settled in the books. It is not usually possible to play a whole game with this background theoretical knowledge available, even if it is so huge as to exclude by far any complete memorisation.

Our beginner, who has only learnt where to search in the books, when playing a real game, for instance by correspondence, will earlier or later find himself challenged by some “new” move of the adversary and will lose his game against any stronger player. Human theory is far from covering all actual positions on the chessboard, especially for the middle game.

#### *Contents of chess theory*

If we examine the books of chess theory mentioned above, we find several parts, or different volumes, containing in particular compilations of opening lines, of middle game elements, and systematic descriptions of endgames. The main procedures that have variously been used for reaching this knowledge – synthesis and analysis – are applied in several sectors of human culture. Synthesis is the tool applied to a set of countless games played in order to derive basic theoretical guidelines, general suggestions for good play. Analysis can be applied to each and every game, or even move; differently from synthesis, by analysis it is possible to directly deduce the game properties starting from its rules, and verifying their consequences, even without any actual competition involved.

#### *Chess solution*

As mentioned above, the theory of games considers chess as one of the family of two-person games, zero-sum, with perfect information. The theory is not yet able to answer whether the advantage of the first move is enough for winning the game. (If some extrapolation from high level play is allowed, we are strongly tempted to conclude that it is not.) In principle, however, chess – as any other else game of its family – can

be solved by playing the “perfect” game, free of any mistake. We have not only seen that this game cannot yet be played, but also that its exact result is still unknown to us. Probably, many years will have to pass before the perfect chess game is found that makes further play useless – at least, if intended to contribute to knowledge of the game. But this idea is so fundamental that it is worthy of a short discussion.

### *Quantitatively toward the perfect game*

The perfect game contains no mistake. Every move is the best possible one, from the beginning to the end of the game. Thanks to recent progress in computer chess, it is now relatively easy to imagine a game of this kind. Chess programs use evaluation functions that allow a quantitative assessment of any game position. A numerical value can be attributed to any move. The choice itself of the move to play is determined by its numerical value, or – which is the same – by the difference it introduces in the numerical value corresponding to the whole position on the chessboard. Sometimes two or more moves have the same value or have values with a difference too small to be significant. In such cases, the program either always plays the same move or arbitrarily selects one of them, depending on switchable settings. Sometimes there are positions on the chessboard that can be played following either of two (or more) symmetrically equivalent lines. If two lines differ only for symmetry – to begin with mirroring left and right – they can be considered as belonging to a single game.

A computer is still unable to play the perfect game indicated above, because this would first of all require a perfect evaluation function to be inserted in the program, and nobody yet knows it. However, the system is clear and indicative enough: it can be summarised in the possibility of assigning a theoretical value to each and any move.

### *Stages to perfection*

1. God-god. We can imagine the perfect game as the third of several steps, in which two perfect players – let us call them gods for short – are playing against each other, without inserting any mistake in their moves. The game they are playing is extraordinary to the point that it could be endlessly duplicated, apart from symmetrical variations. Once this one game has been played, the game of chess is finished. There is no longer anything to play. Both gods will choose to play another game, instead of continuously repeating the same moves, symmetry apart.

2. God-human. The second step would be god against a human player. This already has a more familiar character for us. Now, countless really different games can be played, because error-free moves are only entered from one side of the board. Against god, any human player can at most hope to obtain a draw once in a while, among many lost games. It should however be possible for the human player to repeat his exploit, if once achieved. If a great number of games were recorded, they would represent the best possible chess theory of the repertoire kind, in which a player selects to be white or black and trains to play one good answer to any possible move of the adversary.

3. Human-human. The first and lowest step, the only one really familiar to us, is a game between two human players. This is how matters go on earth, because no games with god players have yet been recorded.

If passing from the third to the second stage above had the consequence to pass from one to countless theoretical lines to play, now the number of possible lines becomes too large to be exhaustively analysed. Each and every move – with the exception of a few cases in which one answer is forced, or visibly better than others – is nothing else than one among several reasonably possible moves. It is mostly this aspect of branching multiplication that lets opening theory be such a complex matter as it is. The tree of the alternative moves increases so fast that even with the most powerful computers an arbitrary cut is usually adopted, after analysing a conventionally permitted number of subsequent moves.

#### *Game stages and corresponding theories*

Players know that the amount of chess theory available varies with the progress of play. It is commonly accepted that a chess game can be roughly divided into subsequent stages: an opening phase, followed by the middle game, and the endgame. Usually, the less “theoretical” a given chess position is, the more reflection time it requires on the board.

A typical control of time used during a game shows that players went fast in the initial one-two dozen moves, when they followed theoretical paths, slowly advanced through the following one-two dozen moves, when they had to answer to out-of-the-book moves of the adversary, again they moved fast in the final stage because (in addition to the usual time pressure, due to tournament conditions) the corresponding positions are again better known from the theoretical point of view.

Chess theory has grown in the course of centuries, but only for simple endgames it has reached the stage of a perfect game.

### *Endgames*

Whereas a specific endgame technique is needed everywhere, only a few endgames have an entirely theoretical development. They are those, which are “theoretically solved”. Any good player, any computer program, here can and should select the same sequence of moves that god would select. Every strong enough player will not play wrong moves. Any move has its fixed reply, the best available.

The progress of the endgame theory is such that we slowly get nearer to perfect play. Theoretical endgames often have their generalising rules and their exceptions, and the connected questions are so complex that only with the powerful computers of recent times many unexpected theoretical exceptions have been discovered. In a few cases, small changes have become necessary in the game rules themselves, as adopted for competition play, especially for limits of moves allowed for checkmating in unusual positions. Compilations have been published and among recent items they have reached the format of whole series of books, such as the Russian collection edited by Averbakh [1980] and the international one published by the team of the Chess Informant [1982].

### *Opening theory*

It is evident that whenever we speak of opening theory we intend something different from perfect play. In this phase of the game, it is possible to avoid mistakes and spare reflection time by memorising specific opening variants, or implementing collections of opening lines within the chess programs themselves. The collection of opening variants are based both on moves occurring in competition practice and in analyses performed by expert theoreticians, who can better judge the expected follow-up of a given chess line. There is a mixture of empirical progress, analytical studies, rough evaluation, which in the course of centuries have established preferred opening lines. About the corresponding compilations, we will have to discuss later on.

### *Basic theory for the middle game*

The theory of the middle game corresponds to chess theory in its analytically least developed stage. One might even maintain that no analytical theory exists here. As often occurs, it is first of all a question of words, of definitions. Which is the difference between theories used in middle game and other phases of a chess game? We can state that for the middle game we have general principles available, as we have for the other phases. For instance, ‘Avoid exchanges of major pieces when a pawn down’ may be the corresponding suggestion for the middle game as, ‘Protect kings by castling’ is in the opening or, ‘Move kings to the centre’ is in the endgame.

Is this theory or not? We can agree that these are basic theoretical principles, deduced from lots of games actually played. They may represent the synthetic summing up of individual analyses of countless positions. Starting from this basic theory, little can be added for the middle game. A certain progress can be obtained by studying the elements of tactics and strategy of chess play; for instance, recurrent elements found in combinations, or in checkmating attacks.

If the theory of the openings is extended into the middle game, it usually considers whole groups of opening variants as an element, or calls attention to particular aspects, as pawns’ moves (see Kmoch [1956]).

### *Tactics and strategy*

Both tactics and strategy are used on the chessboard, as in many other competitions and fights. Usually the difference is explained stating that through tactics single battles are won and through strategy whole wars. In the army, corresponding experts may be a lieutenant and a general, respectively. In treatises on the middle game, the elements of tactics are often described separately with respect to those of strategy (as for ex. Euwe [1935]), sometimes in different books by the same or different authors. However, matters may be more complex and there can be several different levels including, or dividing, the two usually mentioned strategic and tactical ones. Moreover, a given strategic approach or method may become tactical with the evolution of the game or of player’s strength, as discussed, for instance, by Wilcox [1996] and Pratesi [1998] for the game of go.

### *Combination elements*

In addition to general advice, theoreticians have tried and analysed the various aspects that recurrently occur in the middle game, see for ex. Fine [1953]. In particular, major attention has been devoted to chess combinations, which often are the key of brilliant wins on the board. Apparently, chess combinations have an artistic character that seems to be due to an innate talent of the player. However, they too can be systematically investigated and seen as the composition of recurrent elements, which can be studied and then searched on the board individually. The resulting framework is not yet as detailed as it can be found for the opening or endgame stages, but is nevertheless remarkably more detailed with respect to general advices of basic theory, as shown, for example, by a whole volume of the *Chess Informant Encyclopaedia* [1980].

### *Connecting the stages*

In the evolution of chess theory, a remarkable success has been obtained by slowly connecting the separate theories, typical of subsequent play stages. Of course, nobody is yet able to proceed fully theoretically from move one to checkmate. However, a significant part of Capablanca's extraordinary strength, for instance, can be explained with his familiarity with middle and end game positions deriving from the openings that he was preferentially adopting. An example may be his rather frequent use of minority attacks – a middle game feature that can be linked to specific openings before, especially queen's gambit, and specific endgames later.

Maybe the first player to have recurrently used this whole-game approach in his systematic training before high-level matches has been another world champion, Botvinnik, who often took his adversary by surprise through unusual opening lines, with whose developments toward middle and end game positions nobody on earth was more familiar than himself. Later on, other Soviet chess players have discussed these problems of the chess theory, see for ex. Suetin [1958] and Alatortsev [1960].



## 2 – Beginning of chess theory

### *Early progress*

The moves of the new bishops and queens did not only remarkably increase the strength of these pieces; they changed the style of the whole game. (We are now ready to admit that they even changed the game itself, but this may be anachronistic if seen from that time.)

Playing an old chess game was hardly suitable for betting, let us just compare it with a throw of dice, for many centuries the best gambling tool. Matters changed when playing *alla rabbiosa*. Now, it became possible from a distance to check with the bishops and, especially, early to checkmate with the new queen. This queen was now by far stronger than the rook, which had been the strongest piece in the different games of chess used before. And any pawn could be promoted to queen in the course of the game, even though with uncertain details in the corresponding rules, for centuries.

### *Partiti*

Apparently, the most frequent way to play chess before its modern form was to play *partiti*. This is difficult to translate, but would now correspond to play problems. Nobody now plays problems, and in particular it would be strange to bet whether in a given position the king can be mated in just four moves, three being as wrong a solution as five. This had exactly become the commonest way of playing chess, before its modern form. The corresponding “theory” was kept in many similar handwritten books. Most of the attention was devoted to whole families of chess positions, in which very trifling modifications (either in the placement of the pieces or in moving them) were able to unexpectedly change the end result. Somebody who was partly familiar with these positions could be in a worse condition than any layman, who did not know them at all. His superficial knowledge of similar positions could let him be confident to winning the bet, and lose it. In a short time, a dozen such “games” could be played and money changed pockets fast enough. A full game could hardly fulfil the same task. First of all, it was too slow in deciding the winner, also due to the long manoeuvres typical of old chess.

### *Opening theory – why?*

When the new opening lines developed, up to building a first framework of our chess opening theory, players usually were not following a systematic approach for searching to optimise moves and counter-moves. An obvious aim was to find and set traps in the opening stage, much the same as for centuries they had done with traps in the end-games. More generally, a theoretical guideline developed based on premature early attacks, strong enough to win rapidly with any player except for the strongest ones. There was also a more serious task to fulfil – to verify how the traditional opening lines withstood the new rules.

Of course, gambling apart, the objective value of opening lines had much to change from the increase in strength of bishops and queens. The “new” pieces had now to be set in motion earlier than it usually occurred before. Just as an example, indicated by Ken Whyld [2003], the so-called Damiano defence (1 e4 e5 2 Nf3 f6) is sometimes mentioned as showing how bad the 17<sup>th</sup> century players were, even though Damiano said it was a bad defence. Before the new game, with the rabiosa queen, this was one of the best defences, and the reason that Damiano [1512] and others gave it was to show that in the new game it had become a bad defence.

### *Opening lines – which?*

There were openings that better satisfied all requirements indicated. Whichever the specific aim or task, with or without gambling, open games and early development of the major pieces were the common answer. We know today that this is just one of the possible ways of beginning the game. On the whole, it has recently become a rather minor way, now mostly limited to the Spanish game, one of the least used in the old times. The investigation by chess players of the various ways of beginning the game and the slow establishment of the corresponding chess theory in the course of centuries is a subject worth of further discussion, but it is easy to understand that the whole progress has not been uniform. Let us be satisfied with this qualitative statement here; a quantitative evaluation will be provided below.

### *Chess theoreticians*

Several names have been kept, in connection with the early history of modern chess; they usually were strong players or expert writers,

seldom both of them. When studying the contribution to chess theory by experts coming from various places and times, the first point to ascertain is whether “our” chess was really intended. For instance, theoreticians coming from the Iberian Peninsula can be considered pioneers of international chess only for some particular opening line, or other stages of the game. Indeed, our castling was not yet accepted in Spain. Now, a chess game without castling is another chess game; it is impossible to use the same theory, except for a few variants.

Even in Italy, different chess games were played in various regions, or towns. Even in the 18<sup>th</sup> century, the greatest Italian experts of the Modena environment were basically improving the opening theory of – another chess game. It was a fortunate coincidence for Greco that he used the “victorious” form of castling. Before him, a remarkable contribution was provided by Polerio, see also the recent academic book by Baffioni [1993].

### *Greco*

Among all the pioneers of international chess, the figure of Greco is outstanding. The reasons are various. The modern form of castling was adopted by a minority in Italy at the time. Fortunately, it was the form in common usage when and where Greco learnt the game. He could select among existing opening lines those that better conformed to the new castling system. This work he performed both in extension and in depth. In particular, he was a strong practical player too, and could provide many opening lines with more or less forced followings, based on strong attacks, leading to brilliant play and often to an early checkmate. He had a series of manuscripts produced to be offered to main patrons encountered; starting from them, a long series of books were then printed, in several languages.

Greco travelled through France and England, countries with strong contrasts. As for early chess history, they could not be considered among the countries of the earliest and strongest players of modern chess, but at the same time both had early adopted the new rules, castling included.

Of course, Greco showed his knowledge through Europe, but this he could do thanks to the common language of the new chess. In one direction, he could immediately address European chess groups with his proposals; in the contrary direction, thanks to Greco we can feel the active presence of chess players from France and England. If analytical

work was locally advancing there, we do not know any particular evidence about it.

In Italy, where chess analysis was early to develop, the opening analyses of the following Modenese school have mostly become useless. A successful Italian chess handbook by Salvioli [1913], which had several editions in the 20<sup>th</sup> century, used Greco's lines as a base for his own teaching of opening play.

### *Early compilations*

We cannot expect systematic treatises on the openings, or other phases of the game, coming from the early times of modern chess. A few lines were described, with short comments and suggestions to players. It was not necessary that the compiler was a strong player; first of all he had to be able in reviewing and selecting existing material.

The conviction that chess technique could be worth printing in a book was rather slow to be acknowledged. Pioneers of such an approach were Italians and especially Iberians. It cannot be by chance if we find so many Iberians (Vicent [1495], Lucena [1497], Damiano [1512], Ruy Lopez [1561]) among the authors of the first chess books printed.

It seems that Iberians were the first to recognise the merits of a written chess theory. Even in Italian manuscripts we find more than once corrections inserted by Spanish chess players. It seems that the best achievement was to associate the Italian practice (as well as the Italian analytical knowledge kept within an oral – or at most a manuscript – tradition) to the Spanish familiarity with printed game handbooks. It may sound strange that Spain excelled for game books. We are well acquainted with the successful series of game books later published in Paris or London, when Spain had such production hampered by the atmosphere of the Counter-Reformation. However, pioneering books had earlier appeared in Spain on draughts, card games (see for ex. Pratesi [1988]), and so on.

### *The tradition of chess manuscripts*

Many chess manuscripts have been kept and can relatively easily be read today. Nobody knows however which fraction they represent of the total production of the time. Most of the chess manuscripts do not show the character of a notebook, used by its owner for recording new ideas, or descriptions of events, or plays. This can sometimes be seen

in just one or two pages at the end of the book, or as a few short comments inserted at the edges of the text. Most of the chess manuscripts belong to families, and this is easy to understand on the basis of only one chess manuscript being usually available for copying. For many years this had been Cessole's *De Ludo* in the whole of Europe, then, at least in Italy, *Civis Bononiae*.

Only a few personages could think of acquiring several different chess manuscripts. They were either rich court personages or strong players or both of them. For common readers (who already were a minority among common people) one chess manuscript was more than enough. If they wished to acquire one, it could easily be copied from traditional sources.

Of course, Cessole's teaching mainly had a moral value and its technical part is hardly remarkable. Nevertheless, it had been for a long time the only chess book available for copying. Having new texts available with more extensive technical parts was of course welcomed. The insertion of original new texts in current chess book was however very limited and its further copying even less widespread. Chess knowledge had a faster progress than it could be followed by the rate of changes in available manuscripts.

#### *Printed chess books*

For us, a printed book is very different from any manuscript of the same time. First of all, we usually can read its references printed, solving at once all our doubts that for manuscripts often involve author, place, date, and so on. This has usually led to over evaluating the contribution of the given book's author, to begin with the originality of his compilation. Any manuscript brought to the press was not significantly different from usual chess manuscripts circulating at the time. It is anachronistic to think of authors in the sense of nowadays, with a player writing a handbook on the basis of his own experience. On the contrary, any printed chess book had chess manuscripts both as sources and derivations (except Lucena's printed book [1497] that hardly could be available for further copying). It was just a different presentation of an item belonging to a traditional series of books, commonly offered as copied manuscripts.

From chess printed books we obtain names of experts, such as Lucena, Damiano, Ruy Lopez, but their personal contribution has been debated for a long time. In particular, every possible passage between

selected manuscripts and extant printed books (and non-extant too, see Vicent [1495]) has been more than once indicated, in either direction.

The task of the researcher would be somewhat easier if the date of the manuscripts compared were as well known as those of the printed books. However, even knowing the date of a book is not a definitive answer to the question of dating the compilation of its contents.

#### *Further reading on early opening theory*

The development of an opening chess theory has probably been the most evident change in the chess literature when passing from old to modern chess. In the course of time, the fraction of chess literature devoted to the opening stage has increased more than any other.

The earliest contributions have more than once attracted the attention of chess historians, and any chess history deals with this topic, more or less extensively. A special investigation was dedicated to early opening theory by van der Linde, who even compiled a whole book [1874] on the subject. He was enthusiast of the theoretical innovations attributed to Polerio, and probably gave him the merit of having personally introduced more theoretical lines than he in fact did.

Later on, another monograph has been published entirely on the same topic by Bachmann [1926], with some additional data from manuscripts discovered in the meantime. Recently too, historians commenting on the books of Lucena [1497], Damiano [1512], Lopez [1561], Greco [1656], and other chess works of the time, have discussed the question of priority in chronological ordering of several openings, and debated which line has to be assigned to which “discoverer”, as done, in particular, by Monté [1998, 2002].

### **3 – Evolution of chess theory**

#### *An opinion on the history of chess*

Chess history has become such a wide sector that it is easy to meet specialists of parts of the matter. For instance, the recurrent presence of chess in general literature and fine arts is a fundamental historical sector, and other partial aspects of the whole topic can easily be indicated. Usually, an expert of chessmen will hardly be interested in the evolution of opening variants, and vice versa. However, it is hard to speak of the

history of a game before any games are recorded; particularly for board games, in which moves can be written and replayed at will.

In human culture, we use the term prehistory, before documents have been found as witness. In such terms, modern chess has an unusually long prehistory! The history of modern chess can be intended to begin with the acceptance of its rules, the recording of games played, the evolution of its theoretical knowledge. As for its actual practice in officially regulated competitions, chess history is even remarkably younger.

Chess history obviously cannot be limited to records of official games. There are many important events occurring near – or behind – the chessboard that are worthy of note. Attention can now be given to big manifestations as chess Olympiads, or world championships, federal organisation, sponsorships, in addition to the recurrent appearance of new moves. However, what has been occurring on the chessboard should form the mainstream line of chess history, so that it is the history of chess moves (in theory and in practice) to become the central nucleus of chess history itself.

Of course, game collections have the more theoretical aspects, the more they include comments and guidelines. As a remarkable project, a whole Encyclopedia, by Levy and O’Connell [1981], can be mentioned, interrupted after its first volume. One of the reasons for its interruption probably was the beginning at the time of a wide distribution of personal computers, with large electronic databases becoming available in various fields, including chess.

*Further reading on the progress of chess technique and practice*

It is not possible to discuss the detailed evolution of chess practice in a few pages. However, people knows that the common way of playing chess has remarkably changed in the course of time; for instance, with more attention recently dedicated to defence and closed games. Several chess authors have precisely used as their guideline an approach based on the historical evolution of chess practice. Sometimes this has occurred in the field itself of teaching chess technique. In these cases, the given author has considered that outlining the development of chess knowledge in the course of time could be instructive for his disciple. Everything is thus reconstructed – environments and personages – with actual practice, on the basis of typical chess games of the time. Let us mention, for instance, a couple of such books, by Reti [1933] and by

Saidy [1972]. Whether these are books on chess technique or chess history can easily be answered: both!

*Structure and contents of opening theory*

At present, nobody knows exactly how our deep acquaintance with opening theory should be modified for approaching perfect play. It seems hardly acceptable that we should cut all lines except one and, on the other hand, extend this individual line completely, from the start to the end of the game. In the course of time, human players have proceeded in the contrary way, increasingly enlarging their theoretical background. Opening lines have been analysed and many new moves and countermoves submitted to practical verification in actual play. The whole knowledge has been summarised, collected, analysed several times. The first impression in checking compilations dedicated to this part of chess knowledge is astonishment in front of the huge amount of variations that have been investigated, in extension and in depth.

Opening lines are typically extended up to critical positions, which can be considered near the end of theoretical play, leading to middle game positions where the overall guidelines usually become of a general tactical-strategic character. The main criterion has been to try for white to keep the advantage deriving from moving first, for black to equalise as soon as possible the position on the board. The progress has not been uniform, and in the following we will try and investigate this point in some detail. However, there is a fundamental reason why a continuous progress cannot occur. In the selection of the best opening lines to play we assist to a kind of dialectics between old and new moves.

Usually a given line preferred by players becomes outdated, thanks to new continuations that show its weak features. Often this is not however a decisive conclusion. After some time, opening lines set aside as outdated are revived by “new” moves introduced by the weak side, which again becomes reliable and strong, and this dialectic process goes on, involving the whole tree of previous and following moves. One of the consequences is that one can never be entirely sure about the soundness of an opening variation – new unexpected moves can deeply change its overall value, as previously assumed.



### *Theoretical contributions*

The theory of chess has had a lot of authors. The problem of detecting who first analysed which opening line is practically impossible to solve accurately. We should usually name an opening with several names, who first analysed it shortly, who introduced it in actual competitions, who extended its analysis in greater depth, and so on. As a result, many current names of the openings have just the meaning of tagging them in a simple way. Instead of authors' names, several "scientific" catalogues of the variations have been devised; it suffices to check the volumes of *Chess Informant* or *Chess Encyclopedia* [1980].

There have been however specialists in the field, who more than others have contributed to the progress of the theory or to the connected activity of collecting the corresponding knowledge in new compilations. A rapid search in these works gives us the names of a few individual authors, such as Greco, Philidor, Alexandre, Steinitz, Reti, Nimzowitch, Bogoljubow, Euwe, Keres, Pachman, and so on.

Their contributions are not comparable. Greco did not introduce a remarkable amount of new opening variants, but his work became largely known, thanks to translations in the main European languages, to begin with the English [1656]. Philidor [1749] changed some common views on the opening strategy, dedicating more attention to pawns' structures – his work was also reprinted many times. Maybe the first useful compilation for our study was that published by Alexandre [1837]. It is one of the finest chess books printed, with opening tables in folio, somewhat reminding musical editions. These tables are not many – 51 as a whole – but most previous suggestions have been summarised here.

Steinitz [1886-95] introduced opening theory in a whole system of strategic balance. Among other authors, Reti [1922], Tartakower [1924], and Bogoljubow [1928] explained the recent conquests of the "hypermodern" school. Nimzowitsch [1925] wrote original texts on closed games and pawns' chains. Keres [1949,1952] systematically analysed open variants again. The relevant contributions of Euwe and Pachman will be mentioned below.

The task however has soon become easier to perform by a whole team of players working together. A significant contribution to opening theory came from Bilguer and all the editions of the *Handbuch* [1843-1916]. Several Prussian players (and Austrian-mitteleuropäisch too, at least in the later editions) contributed to this classical work.

One of the most efficient and less known contribution to chess theory derived from the first World War. A group of strong players taking part to a chess tournament at the beginning of the war were kept together as war internees for a few years. Much of the early theory of Indian openings and other closed games originated from this forced stay, of course not a programmed event.

Next came the remarkable editorial work organised by Euwe. He wrote many books of theory devoted to all stages of the game, after an early complete series of books on the openings [1937-39]. A great increase in opening editions occurred in particular after WW2. Euwe himself continued to produce relevant literature. Of particular interest for opening theory has been his *Schach-Archiv* [1962-86], in an unusual shape, based on loose sheets that could be inserted in the right place, as soon as they were published. Its structure could thus easily fit the actual development of chess openings, both in their practice and theory, although this development is impossible to predict.

The Soviet school of chess has also expressed teams of specialists. Names of leading figures can be Suetin and Boleslavsky for the openings and especially Averbakh for endgame theory. They could coordinate the studies of several specialists (see for ex. Averbakh [1980]). A particular approach of the Soviet opening analyses was toward asymmetric positions, which better could lead to early counterattacks from the defending side. The corresponding literature in Russian is extensive, see for ex. Suetin [1959], but translations became only current later on. For instance, a whole series of German books on the openings was then published, in East Berlin, with some of the best-known Soviet experts as authors, with first volume compiled by Keres [1968].

### *Encyclopaedic compilations*

Let us shortly review a few complete collections of chess openings published in the course of time. Pioneering early works can be neglected here, also because they contained much “foreign” material, such as opening variants established according to different rules of castling, or aimed at handicap games.

The first really modern theoretical handbook was probably the *Handbuch* [1843], first compiled by von Bilguer and finished by von Lasa, with the assistance of many Prussian players, who were involved in developing the chess opening theory, especially for open games. This book contained every interesting topic on chess, from history to theory.

The main part was of course opening theory, but the theory of simple endgames was also present. This milestone edition became a standard reference work, the starting point for any further progress. Another great advantage of the *Handbuch* [1843] has been, later on, its reprinting in further seven updated editions in the course of three quarters of a century. The last edition of Bilguer's *Handbuch* [1916] was revised by Carl Schlechter, again with the assistance of several experts. Two volumes, edited by Mieses [1921] and Kmoch [1930], were published later on, between the two world wars, with complements and new variants.

Around the middle of the 20<sup>th</sup> century, Euwe, Keres, Pachman, and other individual experts published extended compilations dedicated to chess opening theory; some of them will be examined below. Other compilations have been published in recent times. One of the last attempts to provide a systematic collection of opening variants has been carried out by the team of the *Chess Informant*, with Alexandar Matanović as main Editor [1974-79]. From Beograd, Matanović and other Slav specialists have coordinated the contributions of the best theoreticians of the world, for years.

However, the topic has grown to the point that in book form it is much easier to find now monographs on single families of chess openings, or handbooks of the repertoire kind.

### *Computer assistance*

The recent contribution of computers to chess involves many sectors. Programs playing better than humans are obviously able to call attention outside of the environment of chess players, and the event of a chess champion losing a game, or a match, against a computer easily reaches the media. However, the contribution to recent chess progress deriving from the assistance provided by computers through easily building and searching archives has not been less significant.

Today, a compilation of extended collections of games, or of opening variants, can be better produced by electronic means. The advantage of an electronic database with respect to a book edition in many volumes is that the material can be collected in a much smaller space, easily reproduced and, in particular, searched in a much more straightforward way.

Let us just consider opening variations, in which transpositions can occur, so that a given initial sequence enters after a few moves another group of variants. This may be time consuming or lead to mistakes if

searched in the books, while any position can be assessed immediately, and correctly, when electronically searched in a database.

### *Quantitative increase*

We can examine a selection of the compilations indicated above from the point of view of their relative extension. As a first approximation, the increase of the total number of pages dedicated to opening theory can be taken as a measure for obtaining a quantitative evaluation.

Let us begin with the first edition of the *Handbuch* [1843]: there the opening theory is illustrated in tabular form within 318 pages of the book. At the other limit of the reprint series, in the eighth and last edition of the *Handbuch* [1916], the opening section covers no less than 749 pages.

The German edition of Pachman's work [1964-65] already requires four volumes, with 1688 pages on the whole. In the five volumes of the *Chess Informant Encyclopedia*, in its first edition, 2065 pages are required for providing a full coverage to chess opening theory; moreover, the format of this edition is largely based on symbols and abbreviations, so that a large amount of data can be summarised in a few pages.

In conclusion, we can state that the knowledge of chess theory with reference to opening lines has greatly increased in the course of time. Correspondingly, chess players have required thicker and thicker compilations for letting this theory become available to readers. The following Tab. 1 clearly shows the above-mentioned increase of the pages devoted to this topic in the main compilations selected.

Table 1 – Pages of opening theory in selected compilations, see text.

| YEAR | PAGES |
|------|-------|
| 1843 | 318   |
| 1916 | 749   |
| 1965 | 1688  |
| 1978 | 2085  |

### *Searching for guidelines on how to teach chess theory*

Most chess authors and teachers insist on the convenience for any beginner not to memorise opening lines. The basic concept indeed is that for a beginner that knowledge is too much to be useful. In any case, whole collections that analyse as many as possible of the individual

opening lines are still suggested as a reference for checking ideas or suggestions, even if not for directly learning opening theory.

If the goal is that of learning, more concise sources and a kind of simplified theory are required. This can be done if the cut in assisting analytical theory is counterbalanced by providing (as for the middle game) general principles instead of detailed knowledge. Many chess handbooks have similarly chosen to limit the opening treatment to a few initial lines with the addition of general information on the occupation of the centre, its control from a distance, pawns' structures, effect of opening or closing columns, and so on. Moreover, specific attempts have been performed to summarise the knowledge underlying opening lines, the general principles behind full series of opening moves. A whole book by Fine [1943] had this idea already clearly expressed in the title itself.

The Soviet course compiled by Panov, and then co-authored by Estrin, as for instance in its 6<sup>th</sup> edition [1980] can be considered a milestone in the teaching of opening lines. The main idea is to focus attention on variants currently played. They are followed up to the corresponding critical positions. The reader is guided to understand the natural succession of moves leading to such positions, and the meaning of possible deviations. Of course, studying 496 pages on the openings may be considered a greater-than-average task for a beginner (a strong player should already have learnt much of this material), but the strength of Soviet chess players was greater than average too.

### *Opening repertoires*

Several attempts have been tried for letting opening theory become easier to use or to learn, in the shape of reduced compilations, either in depth or in extension or in both of them. The most amazing way for obtaining a useful cut is however to compile an opening repertoire. It is impressive how much a complete treatise of opening theory can be reduced in volume by simply trying and following the approach of just searching the best individual answer to any move of the adversary.

In any opening book, about half moves are seen from white, half from black. If we see the openings from just one side, however, the book's thickness decreases exponentially: instead of one half, it unexpectedly becomes one twentieth or more probably one two-hundredth! This can already be verified in an early example of this kind by Larsen [1967]. It essentially deals with one opening line, Open Spanish seen

from the defending side. It analyses possible variations in the same detail or maybe deeper with respect to major handbooks and this is done in thirty-four pages. It is not surprising that this basic idea has later originated at least a dozen of opening collections of the repertoire kind.

### *Irregular growth of opening theory*

It may be interesting to come back to the main complete compilations for checking the internal evolution of opening theory. What is evident, already on first inspecting the several collections of opening lines, is that the historical growth of the corresponding knowledge has been far from systematic. Instead of a gradual extending and deepening, starting from a few and short lines known, more often different lines have been introduced and investigated. Roughly speaking, the opening variants for open games have been analysed first, than for half-open and queen pawns' games, then for Indian and all closed games.

It has been far from the growth of one tree of variations, it has been more like the growth of a forest! Moreover, the older part of the broad forest is not at all at its centre. Or maybe let us better use another metaphor for explaining the idea, that of a mine. There is a big mountain that has been dug for ores. Pitmen entered it at a given place, but when inside they advanced following the deposits, without any regular progress, with new excavations far away from the origin and a final shape that is very different from any expected symmetrical advancement starting from the earlier works. It is better to define this irregular growth, and possibly determine it, on a quantitative basis.

### *Quantitative historical transformation*

It is possible to check the fraction devoted to the theory of open games in the course of time, using for instance the corresponding page fraction in reference books mentioned above, and the result is shown in Fig. 1.

The resulting information is not surprising, because as a general concept it was already familiar to any chess player with some interest in historical matters; however, the change indicated may be more dramatic than expected. Note moreover that the actual slope shown here is a quantitative measurement, even if obtained from a rough selection of samples.

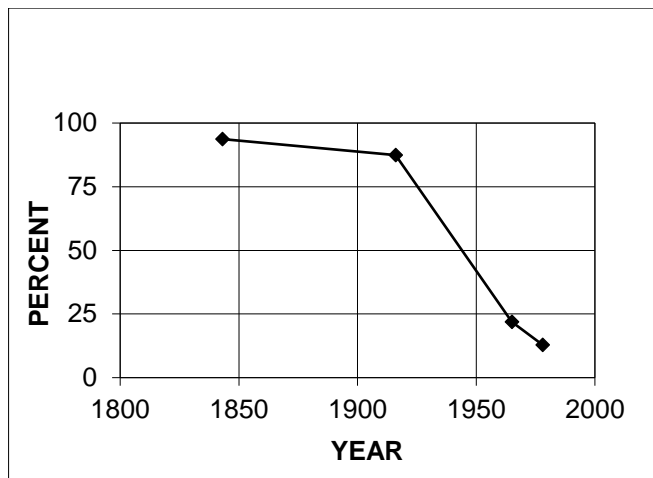


Figure 1 – Fraction of open games

It is possible to perform a similar analysis for various opening lines or their families, so that one follows the change in popularity of the main variants. It is not surprising to find a remarkable increase for “modern” variants, such as Sicilian or Indian ones, but again we now get a quantitative determination, instead of a general impression. The following Fig. 2 provides such results for a few common openings. It will be easy to extend this determination to any other opening line.

#### *Examples from elsewhere*

Some possible reasons for the irregular growth of chess knowledge have already been mentioned, but maybe there is another reason, directly connected with human mind and its learning processes.

Similar developments can be found in completely different fields of the human knowledge. It is thus possible that owning a limited mind has not only effects among chess players. For instance, a kind of parallelism can be indicated with chemical knowledge, if only a comparison of open games with inorganic chemistry is allowed. Inorganic chemistry (which once practically corresponded to the whole of chemistry) is today a relatively small fraction of it, with organic chemistry having conquered the largest part. Here too, the progress of human knowledge has advanced in a way very far from a tree-like development.

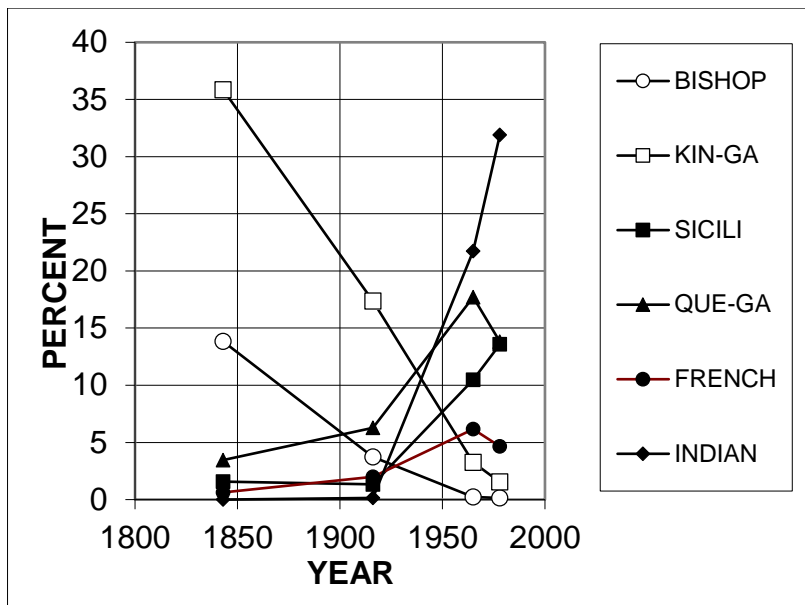


Figure 2 – Fraction of selected opening systems

## Conclusions

A first section has been devoted to relate chess theory to the basic concepts of the theory of games; then its beginning and growth have been shortly described and discussed. Chess theory still assumes different aspects for the different stages of the game, in particular opening, middle game, and endgame. Its essential contents and methods have been outlined for every stage; special attention however has been focused on the opening section. The compilation of the main opening handbooks in the course of time has been reviewed and a quantitative basis has been provided to concepts – generally known, but only in a rather indistinct way – such as the relative decrease of interest for open games and the recent increase of our knowledge in the Sicilian or Indian defences.



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