

**The Symmetrical Chess Collection**  
**[www.symmetryperfect.com/shots](http://www.symmetryperfect.com/shots)**

**A mathematically-sound introduction to the universe of chess variants!**

**31 unique games total**

**03 royal queens games**

**28 royal king games**

**Various games invented and implemented 2002-2005 by Derek Nalls.**

**All are 2-player, 2-D perfect-information games.**

**Games of this class can be studied mathematically under combinatorial game theory as well as plane geometry.**

**Special thanks to Ed van Zon for his advice and guidance along the way.**

**Supreme thanks to the principal architects of the Zillions program for making all dreams possible.**

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## goals and purposes

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I would classify myself as a moderate amongst inventors of chess variants- neither an unimaginative conservative clinging to familiar, standard chess nor a radical embracing all types of crazy gameplay unwisely and uncritically. An optimum balance of highly-desirable game features at their apex exists, unique to this collection, which was extremely difficult to attain- requiring appr. 3 years of work to reach its maturity or ultimate refinement (hopefully).

Of the game designers who adequately understand and respect such theoretics, the majority accept or believe that many desirable game features exist or work intransigently at cross-purposes. Indeed, these inverse relations (which can easily be discovered by anyone experimenting with game designs) possess a mathematical logic which seems to be inescapably true at a cursory glance.

Yet with an incisive understanding of combinatorial game theory (as applied and advanced to a new, formally ill-defined or undefined area of chess variant design) as well as a mastery of the relevant tools provided by the Zillions program, all of the stale or unsavory compromises can be overcome and avoided while an optimum balance can be achieved.

All of the chess-related games in this collection are fast and dangerous yet extremely deep theoretically and almost-perfectly stable. All of the chess-related games in this collection are easy to start playing and enjoyable yet hard to master.

Besides being symmetrical in every measurable way attainable for 2-player chess variants (which is to be expected), all of these games are virtually perfect in every measurable way.

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## the Zillions Of Games program

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Quality chess variants can only be created in accordance with ALL knowable, valid, important theoretical design principles available to the present day ...  
IF the knowledge and tools available to the present day are adequate.

My assessment is that they are definitely adequate today and probably, today's standards or definitions of quality will always remain adequate. However, until only several years ago [note- The Zillions program was introduced in 1998.], adequate knowledge and tools certainly did not exist. Incidentally, the odds against creating a quality chess variant by chance involve combinatorically-high values.

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## blueprints for incredibly bad inventions

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Overall, the literature of chess variants demonstrates a random scattering of 1000's of the infinite possible, stable [not in every case!] arrangements of boards, pieces, rules, etc. Despite the constructive intentions, hard work and abstraction by their various inventors, it is as if the population as a whole which created this class of games did so without any guidance of intelligent design. Nearly all of these games could have instead been randomly generated by a computer running a program designed to create poor chess variants. This is the fate of nearly all work undertaken without correctly applying the most important game-design principles.

Unfortunately, since the advent of the Zillions program, the vast majority of the numerous, new chess variants have NOT improved in non-trivial ways. The bad examples of ancient and/or popular work worldwide continue to inspire, misguide and be used to disastrous ends.

Standard chess, for example, is a yet another poor game. [It is asymmetrical, abstract junk with an appalling absence of most quality criteria.] For it to be otherwise would be a miracle considering its ancient, piecemeal development. Those who are unable to accept this reality may still be able to play and enjoy chess variants (including standard chess). Notwithstanding, they will likewise be unable to correctly discern between a high and a low quality chess variant due to their deficient understanding of this subject.

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## the supreme importance of symmetry

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The importance and preferability of symmetry is generally under-estimated today by most "schools of thought" in the chess-variant world.

Essentially, the situation as I see it is that most "schools of thought" are failing to think much since they have complacently allowed themselves to remain disgracefully uneducated to some important, modern areas in mathematics, geometry & combinatorial game theory which are relevant as well as vital to what they do. Their arrogant lack of respect, comprehension and even interest in the key ramifications of modern mathematics (in particular) and the scientific method (in general) is shocking.

They have failed to definitively break free from the stagnant paradigm of tradition (which notably requires little rigorous work). Perhaps, their failure is rooted in thinking of their endeavor purely as artistic instead of scientific (as it definitively is).

With chess variants, mathematics is much more than an assortment of tools for subserviently measuring the incidental characteristics of the art of arbitrarily-designed gameworks. Instead, mathematical game-design principles, correctly applied, determined the amount of substance or quality within the art of gameworks.

Using mathematics a bit does not assure that one's endeavor is scientific. Understanding mathematics as well merely makes one capable of attaining scientific standards ... with the unavoidable investment of great amounts of rigorous work.

ALL games which are NOT symmetrical, including standard chess, are NOT worth playing- chaos & abstract junk. They should not be regarded as anything more than an unfinished, failed or flawed attempt to create a perfect game. The main reason is that asymmetry greatly, adversely impacts many other critically-important game design factors such as structure, function, stability, fairness, balance and equality- all of which, by definition, are related to symmetry.

**Strict Rule-** Any asymmetrical game is an imperfect game.

[Note- This does not at all imply that any symmetrical game is a perfect game. Several other important criteria besides symmetry must also be in place to invent a perfect game.]

Unfortunately, appr. 90% of the games published upon the Zillions Of Games web site & the Chess Variant Pages are asymmetrical and as such, fall into this "total waste of time" category. Of the balance of appr. 10% symmetrical games, most are badly designed or imperfect. This hardline view (interpreted as "radical" by those who fail to recognize its mathematical foundations) is what inspired me to become a diligent game designer in the first place. I wanted to do something right which I could clearly see most were-are doing wrong.

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the hazards of careless invention

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People who do not understand chemistry should not brew explosives, despite the temptations. Chess variants involve some important mathematical principles approachable from various viewpoints such as combinatorial game theory, AI (computer science), set theory, combinatorics-permutations, statistics, vectors, geometry (symmetry), logic at levels of design, playtesting and analysis, etc ... which will almost surely be screwed-up by any game inventor with an inadequate or absent comprehension.

The relativistic view that a universe of personal preferences are at work, that anything uneducated game designers and uneducated game players agree to liking must be equally good, denies the fact that sound, provable, scientific criteria for game quality comparison or improvement exist in theory or can be created. Admittedly, I am not implying that such activities by inventors and players are harmful, though.

Although inventing games can be regarded as a creative endeavor or process and it is an admissible possibility that the finest goal is to cause fun, excitement, mental stimulation for the human player(s), whenever mathematical criteria are available to make determinations regarding desirable game characteristics, it is imperative that they be used instead of discarded.

Make no mistake. You are walking into a thick mathematical jungle when you presume to have the authority to invent as many as ONE chess variant for the rest of the world to play. If you ignore any of the knowable "signposts of quality", then you are likely to get lost. Arrogant imaginings to the contrary will change nothing. Thereafter, you will probably create "nothing but abstract junk" which will someday- perhaps soon- be identified correctly as "nothing but abstract junk". Then, your legacy will be ridiculed and rightfully so for distracting and annoying serious players and game inventors via "your voluminous, incoherent messes". That could not be anyone's goal for the sake of the work they are undertaking.

Unfortunately, these desperately-needed "signposts of quality" are mostly unknown at present to formal, combinatorial game theory. Besides, branches of mathematics concentrate only upon measurement- not value judgments ... even those important enough to define quality. Hence, one must invest much of their own time creating original work thru theorizing, playtesting, experimenting with game designs ... to attain and refine game-design principles which one has compelling reasons, based upon geometric and combinatoric truths, to believe are valid or optimum.

Some people foolishly believe inventing great games is as simple and sure as running down pedestrians with a fast car. [No need to look back, either.] In actuality, the tremendous complexity innate to chess variants renders this view false to the extreme. Nonetheless, the Zillions program makes it as user-friendly as possible for novices to slap together new games. To be sure, I must approve fully. Unfortunately, nearly all new games of this origin are poorly conceived. Overall, this "conspiracy of opposite extremes" contributes to "bad game pollution" which is already a problem and destined to reach a highly-disruptive level within a few-several years for serious players in search of quality games.

One must work very hard to invent quality games. Most people who, for reasons I will never understand, wildly imagine that they have a neat game to give to the world, fail to do the latter (if not also the former). Ironically, although playing quality games should be fun, inventing, implementing, playtesting, refining quality games is definitely not fun. It is rigorously hard work which can send a developing game thru many versions. Fortunately, the creative process is theoretically interesting and successful achievements are satisfying.

Only those who appreciate and understand mathematics and geometry with earned competence (formal and/or informal) are in a position to craft chess variants which fully unleash the power of their vast possibilities. After all, they are combinatoric, dynamic, mathematical machines operating within a geometric, closed universe by nature or definition.

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### the satisfactions of thoughtful invention

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The mathematical nature of the universe of chess variants is ever-intriguing. I approach this subject as a 2-D geometrician. I never expected to find so many interesting geometric patterns, angles, arrangements for boards & pieces, suitable for creating unique, quite-playable games, while restricting myself to using only sliding pieces of unlimited range. After all, I only allow a couple of special moves (promotion, demotion, portal travel) which I consider play-enhancing to be used in any of my games. I have critically examined nearly all of the many other special moves possible in detail and found them to be play-degrading or destabilizing (in ironic contrast to their inventors' intent).

I have always imagined that the BEST possible arrangements of boards and pieces suited for creating games that are thrilling to play is limited. However, it is an admissible possibility that I am flat wrong- that only my imagination is limited. It seems ironic that I have always strictly used an increasingly-long list of quality criteria to keep the number of my creations as low as possible yet 31 games (which I regard as a moderately large number) currently exist in my catalog. The "freedom I allow myself to restrict" defines my unique style and protects the quality (by my effort to establish standards mathematically).

All of these games have many common characteristics and overall continuity as they span a spectrum or lineage of unique methods for seemingly-mature adults to "fight intensely over a king ... or a queen".

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## **move-intensive vs. rule-intensive games**

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**Chess variants are visual, geometric games at heart- consistently with what is evident- and I have firmly ascertained that this is the best expression available creatively. Notwithstanding, chess variant designers hold the power to build their games to function anywhere along a wide scale between purely move-intensive (visual, geometric) and purely rule-intensive (non-visual, conceptual). Some make a poor choice at this critical juncture.**

**Rules should not be highly-complex for chess variants.**

**[Yes, this is a rule.]**

**In playtesting, I have found that games with highly-complex rules, no matter how conceived, always degrade instead of enhance the level of play (e.g., excitement, danger, depth). Furthermore, it gives the players headaches just trying to keep the rules straight to be sure to make legal moves instead of focusing upon plotting their next move tactically and strategically (which is where the enjoyment within the game lies).**

**Rules of simple to moderate complexity can be implemented using Zillions where many consequent advantages for the universality of one's games materialize. Over the coming years, the Zillions program will continue to improve and it is probable to become legend eventually that any chess variants without a Zillions-implementation might as well not exist.**

**Of course, some chess variants with highly-complex rules exist. [Many do not have Zillions implementations. Some may eventually with great effort.] They are always awkward, tedious and unenjoyable games which compel one to wonder what the constructive purpose for their invention could have been in the first place.**

**To be sure, all of the games within this collection are move-intensive to the maximum extent possible and rule-intensive to the minimum extent possible.**

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the ideal number of players

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Typically, 1-player chess variants are merely geometric puzzles classifiable as trivial (i.e., solvable) games. Their complexity must be limited to what is reasonably solvable by intelligent people (of less than genius level) thru trial-and-error methods to hold adequate purpose, incentive or enjoyment for the general game-playing public. Unfortunately, once solved, then they can be solved in exactly the same way any number of times. When a game becomes totally predictable, it not only is no longer fun- it is pointless to play.

Having numerous, graduated skill levels can keep a 1-player game interesting and challenging for a while longer but inevitably, thru success and/or frustration, their human player naturally loses interest within a short time. The educational lessons imparted by games of this class may have lasting value, nonetheless. Otherwise, their theoretical depth is insignificant compared to chess variants with 2 or more players. Furthermore, 1-player games must be asymmetrical and they cannot accommodate any opponents, human or computer (obviously).

Games with 3 or more players always play-out in a manner, by accident or design, which unfairly distributes advantages and disadvantages, large and small, to every player in the game. It is not possible to stabilize a game with 3 or more players against this complex effect given force by the cumulative activities of every player. Furthermore, no individual player holds adequate power, being outnumbered by players of equal power, to prevent this complex effect from having great impact upon one's self (and every other player) in every game played.

The intolerable problem with this situation is that it becomes quite possible for the player who played best to NOT actually win some games.

Only in games with exactly 2 players is this complex effect totally non-existent as each individual player holds equal power with only one opponent in the game. Moreover, the player who plays best is guaranteed to win the game. In summary, 2-player chess variants can be significantly theoretically deep, symmetrical and they can accommodate opponents, human or computer (obviously).



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the best possible board geometry

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Chess variants have the amazing distinction of being amongst the most complicated games known (by combinatoric measure) which are classifiable as perfect-information games. With the exact location of all types of pieces on the board defined physically to certain spaces, all pieces play-out with visual, geometrical clarity. The board is essentially a geometric playground or finite universe of small, manageable size within which the pieces can be played in an extremely vast (although finite) variety of ways.

All of the chess-related games in this collection are played upon boards which, with the pieces for each of the 2 players set to their opening positions, maintain perfect bilateral, geometrical symmetry via vertical and horizontal axes.

Games built upon boards constructed of spaces can be best accomplished using regular polygons that can be replicated without creating unused gaps of space. This leaves only spaces with 3 sides (triangles), 4 sides (squares) or 6 sides (hexagons) which meet the criterion. The maximum number of geometrically-contiguous directions of movement available with triangular spaces is 12, with square spaces is 8, with hexagonal spaces is 6.

The 6  $60^\circ$  angles dealt with on hexagonal-spaced boards are all familiar to triangular-spaced boards yet hexagonal-spaced boards have fewer directions of movement available than square-spaced boards. Clearly, there is no comparative advantage to designing hexagonal-spaced games instead of triangular-spaced games unless for the novelty. So, I have created no games based upon hexagonal-spaced boards for this collection.

Square-spaced boards are unique compared to triangular-spaced boards due to 4 of their 8  $45^\circ$  angles being unfamiliar to triangular-spaced boards.

Triangular-spaced boards are unique compared to square-spaced boards due to 8 of their 12  $30^\circ$  angles being unfamiliar to square-spaced boards.

In my experimentations with triangular-spaced boards, inequities between the values its two color-bound pieces (i.e., even-filed and odd-filed rooks) defeated my every attempt toward geometric solution leading me to the tentative conclusion that any solution is impossible (at least, for games with my design characteristics). So, I have created no games based upon triangular-spaced boards for this collection.

Consequently, all of the games in this collection are based upon square-spaced boards. Note that all boards maintain vertical and horizontal axes of symmetry instead of diagonal. This is due to the strong desirability of maintaining equality of piece values between its two color-bound pieces (i.e., light-spaced and dark-spaced bishops) throughout a game.

A maximum of 200 live, contested squares within a maximum dimension (H or W) of 24 squares overall (at 32 x 32 pixels per) via small display or 12 squares overall (at 64 x 64 pixels per) via large display are allowed for the board. Games with a maximum dimension (H or W) of 12 or less squares automatically open using a large display but offer the option (if needed or desired) of conveniently reducing to a small display. Games with a maximum dimension (H or W) of 12-24 squares use only a small display.

Accordingly, a monitor and video card capable of attaining a resolution somewhat greater than 768 x 768 is indispensable to display the largest games in this collection. [Note- The program itself requires some amount of additional space around the board.] With the "enlarge board" (2x) feature built into the Zillions program also available to use in tandem, 2-3 different sizings, each twice as large as the previous, are possible for the various games.

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the best possible pieces

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Sliding pieces of unlimited range are the only types of moving pieces used in any of these games because they utilize every board spaces in their given directions of movement. Sliding pieces of limited range are undesirable because they unnecessarily slow down the game and severely reduce move options.

Essentially, leaping pieces are out-of-tune, ill-fitted to their geometric environment as they waste or miss spaces and often move at odd angles to contiguous, available board spaces. Moreover, leaping pieces must be of limited range since royal pieces cannot be defended from leaping pieces of unlimited range by interposing other pieces. I interpret it as proof that leaping pieces are foundationally-defective since they will destabilize a game if extended from limited to unlimited range.

Generally, a minimum of 24 combatant pieces per player are required at the start of the game to insure stability for any 2-D game (where only sliding pieces of unlimited range are used). Furthermore, a minimum of 36 combatant pieces per player are required to prevent draws from being too commonplace in royal queens games. Finally, a maximum of 48 combatant pieces per player are allowed to retain human playability for any 2-D game.

Within all 31 games, there are 11 major, unique sliding pieces used or usable with 4, 6 or 8 directions of movement upon a square-spaced board. Some pieces do not start the game on the board yet can potentially be brought into play via the promotion and/or demotion of pieces which do.

Additionally, there are 4 minor, unique sliding pieces (i.e., horizons, verizons, diagons [I & II]) with only 2 directions of movement (as opposite rays) used in some games. Capable of moving only along a line which cannot be rotated, they exist merely as 1-D pieces "stuck-in-a-rut" on a 2-D gameboard. However, they can be promoted in 2 moves into a choice of 2 2-D pieces with 4 directions of movement. Starting the game on the 1<sup>st</sup>, 2<sup>nd</sup> and/or 3<sup>rd</sup> front lines (ranks) as buffer pieces (or their descendants), they strongly influence the opening game as some get either captured or promoted out of existence.

The 2-D symbols used to represent all sliding pieces are visually indicative of the directions in which they are capable of moving in 2-D. Their geometric, straight-line 1-D move chosen is as a ray visually clear, direct and as sensible as a beam of light.

There are 11 sliders theoretically possible in 2-D with 4-8 directions of movement (in pairs of opposite directions). Of the 11 major, unique sliders, 3 are "symmetrical sliders"; 8 are "asymmetrical sliders".

A symmetrical slider is invariant under transformations in its movements with respect to 4 axes which can be cut across the 2-D board orthogonally or diagonally. Likewise, an asymmetrical slider is not invariant under transformations in its movement with respect to 4 axes which can be cut across the 2-D board orthogonally or diagonally.

[Note- It is permissible for me to use these asymmetrical pieces within symmetrical games because they are carefully balanced geometrically in pairs in their opening positions by an appropriate arrangement to achieve symmetry overall- by the most holistic definition.]

The 3 symmetrical sliders are already familiar to anyone who has played chess. Of the 3 symmetrical sliders, 2 are 4-directional; 1 is 8-directional. They are the bishop (4-directional: diagonal), the rook (4-directional: orthogonal), the queen (8-directional: diagonal & orthogonal).

The 8 asymmetrical sliders are unfamiliar to everyone except a few who are already familiar with my gameworks. Of the 8 asymmetrical sliders, 4 are 4-directional; 4 are 6-directional. They all have a mixture of 2 or 3 orthogonal and diagonal component to their movements.

The 4 4-directional asymmetrical sliders are the "zig-zag" (4-directional: horizontal & NE-SW diagonal), "zag-zig" (4-directional: vertical & NW-SE diagonal), "zag-zag" (4-directional: vertical & NE-SW diagonal), "zig-zig" (4-directional: horizontal & NW-SE diagonal). A few royal king games based primarily upon these pieces always have "ZZ" within their names to signify the heavy presence of "ZZ pieces".

All 4 6-directional sliders are asymmetrical. The 6-directional asymmetrical sliders are the "horizon-bishop" (6-directional: horizontal & diagonal), "verizon-bishop" (6-directional: vertical & diagonal), "diagon-rook I" (6-directional: orthogonal & NW-SE diagonal), "diagon-rook II" (6-directional: orthogonal & NE-SW diagonal).

They do not actually start any game already upon the board. Instead, they can be attained thru the promotion of 4-directional sliders at the cost of 2 moves. [In fact, all combatant pieces (except the queen) can be promoted into other pieces capable of 2 additional directions of movement at the cost of 2 moves.]

In some royal king games, they can be demoted at the cost of 1 move back into 4-directional sliders capable of moving in the 2 directions they cannot and unique from the ones they were originally. This ability is only rarely beneficial yet significant since blindside threats against 6-directional sliders are precarious as the threatening piece can itself be captured in only 2 moves.

Of the 11 major, unique sliders, the queen is the only 8-directional "universal slider", 4 are 6-directional "composite sliders", 6 are 4-directional "basic sliders".

A remarkable reality of game design is that where only sliding pieces are used, a single, best opening setup for a given board game is always precisely, tightly definable. In contrast to nearly all chess variants invented by others, the chosen opening setup for every game is NOT determined arbitrarily (i.e., as one of many adequate possibilities) or thru hopefully-intelligent guesswork. If either were the case, the yielded result would almost surely be less than ideal.

Furthermore, from the exact board design, it can be determined exactly which sliding pieces are used, in exactly what numbers and their exact opening setup. The principle is elegantly simple. Nonetheless, the exact board design required for a game is not known at the beginning of the invention process. Its determination entails a complex, interdependent process wherein the board design must be adjusted and tested to accommodate the needed sliding pieces appropriately arranged to meet all offensive and defensive requirements.

[Admittedly, many quality criteria not mentioned or fully explained within this essay are also involved.]

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### 3-D chess variants

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There are only a handful of people currently creating chess variants for 3-D. I am not one of them nor do I ever intend to consider becoming one of them until-unless the Zillions program is rewritten to handle 3-D graphics well.

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### minimizing the first-move-of-the-game advantage

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Game stability is maximized where there exists perfect balance.

An absolutely minimal first-move-of-the-game advantage (by white) is assured due to a balanced white-black-black-white move cycle, the use of buffer pieces and opening positions in which neither player can capture an opponent's piece within 2 moves (unless willing to also capture one of his/her own pieces of equal value beforehand), trap the royal pieces (which are very well protected) or irrefutably take decisive positional or material advantage.

White and black are insured an equal number of moves and moreover, an equal number of innings led before the game can end due to the capture of the first royal piece. This must be at the completion of the current 4-move cycle.

The first-move-of-the-inning advantage alternates fairly between the 2 players via a "pendulum move" scheme. It is so-named since an advantage or disadvantage of never more than 1 move alternates between the 2 players throughout the entire game.

Under the "pendulum move" scheme, only the very first and very last moves of the game are single moves which are made by white. Throughout the body of the game, double moves alternate between the players. Although this unconventional move cycle was adopted to vastly improve game stability, it has the beneficial side-effect of greatly increasing the theoretical depth (since it is dependent upon the variety of possible ways a player may use the 2 moves comprising his/her turn).

Of course, a double-move can be used to move the same piece twice. This would account for a squaring (exponential increase) of the theoretical depth. Furthermore, a double-move can also be used to move two different pieces once and for many different purposes- offensive and/or defensive. Hence, a hyper-squaring (hyper-exponential increase) of the theoretical depth is the correct formula.

Of course, there is (as there must be) absolute equality and mirror-image symmetry between the 2 armies at every opening position in every game. With rare exceptions, bilateral symmetry is destroyed for the rest of the game after the first move (by white).

Buffer pieces are employed to prevent both players from being able to capture an opponent's piece using their first available double-moves (short of sacrifice) thereby dominating the tempo of the opening game.

Two main types of opening positions span this game collection: confrontational and non-confrontational.

In non-confrontational opening positions ...

Frozen bishops (incapable of movement) can be promoted into bishops at the cost of a move.

This arrangement occurs only within some royal king games.

Two relevant sub-types of confrontational opening positions occur, distinguished by starting piece densities: non-saturation (<100%) or saturation (exactly 100%).

In confrontational opening positions at non-saturation (<100%) ...

1. Horizons (capable only of moving along a horizontal line) occupy the 1<sup>st</sup> front line (rank) where they can be promoted into a choice between 2 out of 4 4-directional asymmetrical sliders at the cost of 2 moves. Specifically, it is between the zig-zag and the zig-zig.
2. Verizons (capable only of moving along a vertical line) occupy the 2<sup>nd</sup> front line (rank) where they can be promoted into a choice between 2 out of 4 4-directional asymmetrical sliders at the cost of 2 moves. Specifically, it is between the zag-zig and the zag-zag.

This arrangement occurs only within some royal king games.

In confrontational opening positions at saturation (exactly 100%) ...

1. Blocks (incapable of movement) occupy the 1<sup>st</sup> front line (rank) where they can be promoted irreversibly into a choice between one of two routes:
  - A. At the cost of 2 moves, the promotion is a choice between 2 out of 4 2-directional sliders (asymmetrical). Specifically, it is between the diagon I (NW-SE diagonal) and the diagon II (NE-SW diagonal).
  - B. At the cost of 3 moves, the promotion is into a queen.

2. Horizons (capable only of moving along a horizontal line) occupy the 2<sup>nd</sup> front line (rank) where they can be promoted into a choice between 2 out of 4 4-directional asymmetrical sliders at the cost of 2 moves. Specifically, it is between the zig-zag and the zig-zig.
3. Verizons (capable only of moving along a vertical line) occupy the 3<sup>rd</sup> front line (rank) where they can be promoted into a choice between 2 out of 4 4-directional asymmetrical sliders at the cost of 2 moves. Specifically, it is between the zag-zig and the zag-zag.

This arrangement occurs within all of the royal queens games.

A great deal of theoretical groundbreaking, playtesting and measurement has gone into devising and refining the various buffer piece systems used in every game. Nothing about the details of each was arbitrarily determined. Absolutely no more buffer pieces than necessary are desirable since this would pointlessly render a game uneventful and tedious. Absolutely no less buffer pieces than necessary can be tolerated by any means since this would catastrophically render a game unfair and unstable.

As a general principle, a greater presence of buffer pieces is needed for confrontational opening positions than non-confrontational opening positions AND for saturation starting piece density (100%) with confrontational opening positions than for non-saturation starting piece density (<100%).

To further assist players, the attack value component of the material value of the sliding pieces has been calculated manually and is included in the "strategy" section. To be sure, relative piece values (a weighted, holistic calculation of positional and material values) are automatically generated by the Zillions program and can be accessed by players. These complex calculations are typically inaccurate, though, to the limits of the strength of play of the Zillions program. Thus, I still regard the accurate, relatively-simple calculation of attack values as a useful, clarifying reference.

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## game-ending conditions

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In every game, there is only one method of victory- to terminate a royal piece belonging to your opponent. This may be a single "frozen king" which is totally incapable of movement or the last of 4-8 royal queens which are capable of movement to the maximum extent. Hence, an important division between the "royal queens games" and "royal king games" is observed within this collection.

In royal queens games, victory can always be achieved by capturing the last royal queen or compelling it to resign. [Be mindful that more royal queens can be promoted into existence from any remaining blocks at the cost of 3 moves.] The accessible board geometries, movement capabilities of the queen and the commonplace double-move assure conclusive endgames.

In royal king games, victory can always be achieved either by capturing the frozen king or by compelling it to resign.

Under either scheme, the chances of a draw are minimized. Notwithstanding, a draw remains possible if both players capture either each other's last remaining royal piece within the same 4-move cycle. When one player has his/her last-only royal piece captured, only 1 move is left for white and only 0 or 2 moves (depending upon where within the move cycle the royal piece capture by white occurred) are left for black to reciprocate- thereby achieving a draw instead of a loss. This "equal innings led" rule must be admissible to maximize fairness, equality, balance and stability.

This is not to imply that there is only one method of defeat, however. Repeat a position 3 times and find-out! Unlike the rules for standard chess, bad sportsmanship (i.e., evasively or stubbornly looping the game) is NOT rewarded within any of these games.

In royal queens games, it is also possible to conveniently, non-verbally resign at any point in the game by converting all of one's own remaining queens into non-royal pieces or by capturing all of one's own remaining queens with other pieces. The number of moves required depends upon the number of royal pieces remaining.

In royal king games, it is also possible to conveniently, non-verbally resign at any point in the game by converting one's own frozen king into a non-royal piece or by capturing one's own frozen king with another piece. The number of moves required is always only one.

I consider it preferable to make resignation a defined, legal move formally recognizable in the move list.

As a general principle, it is rare for capturing any of one's own pieces to ever be beneficial in any situation but stay alert to the tactical possibility because it truly does arise (and sometimes with important consequences when it does).



In royal queens games, due to the mobility of the royal pieces (queens), the endgame can be especially unfocused, unanchored and complex. Even the opening game is moreso than with royal king game counterparts. Furthermore, the queens may opt for the gambit of being used for attack instead of merely being defended. Finally, any blocks your opponent may have left at the endgame must guarded against or captured (at a cost to you of some moves) since they can be promoted into queens at the cost of 3 moves (to your opponent).

In royal king games, the conflict between the 2 armies is maximized or sharp focused along the vertical line running between the 2 frozen kings [also, the vertical axis of symmetry] where both the defense of your frozen king and the offense against your opponent's frozen king entail interposing pieces and/or establishing lines of attack. This effect throughout the game intensifies as the endgame is approached.

In royal queens games, the boards are such that queens can be attacked from 3-8 angles (always a mixture of orthogonal and diagonal angles) depending upon which gameboard applies and their position within its geometry. The fatal line of attack is equally likely to come from any angle.

In royal king games, the boards and opening position of the royal piece are such that the frozen king can be attacked from 3 or 5 angles- always a mixture of long-range and short-range angles; always a mixture of orthogonal and diagonal angles. The fatal line of attack is equally likely to come from any angle.

Overall, the royal queens games and royal king games are complimentary to one another with respect to the realities they bring alive to these gameworks. Hence, having both contrasting game types (instead of intolerantly, unwisely choosing one over another) is an indispensable contribution to its holistic balance and variety.

In royal king games, any conceivable board geometry must be investigated as an admissible possibility for basing a game upon (although the simplest, ideal shapes are diamonds and hexagons). In royal queens games, ONLY the simplest, ideal shapes are acceptable for basing a game upon: rectangles and octagons. Hence, there are far more royal king games than royal queens games.

Although any game can end suddenly as a win, loss or draw (for white or black) in the phases developmentally known as the opening, mid-game or endgame, no game in this collection which reaches the endgame can possibly end in a draw due to insufficient material or positional inability to make progress toward ending the game. In other words, draws still can and sometimes must occur but never thru stagnation- only thru the mutual capture of royal pieces (within the same-numbered turn). This is an extremely desirable feature for players- unique to this collection of chess variants.

### **In royal queens games ...**

**At the greatest reduction of material possible (for a game not yet over) in any of these turn-based games, both players must still possess one mobile piece and it must be a royal queen. Consequently, the first player who has the opportunity to execute a double-move with his/her royal queen can hit any square on any board in any game to capture his/her opponent's last royal queen. So, a win can be forced every time.**

### **In royal king games ...**

**Since the royal pieces belonging to both players (the frozen kings) are immobile and thereby incapable of capturing, it is impossible for both players to equally end-up without any mobile pieces at all besides them. In other words, if the last mobile piece belonging to one player is captured, this must be done by a mobile piece belonging to the other player.**

**At the greatest reduction of material possible (for a game not yet over) in any of these turn-based games, one player must still possess one mobile piece in addition to one's frozen king while one's opponent would possess only a frozen king.**

**Regardless of the type of mobile piece this one example piece happens to be and regardless of its location on any given gameboard (even one with a complex, fragmented geometry), it will be sufficient to reach and capture the target frozen king within a few moves at most.**

**In the worst case scenario ... even if the target frozen king exists on the opposite spacing as that of a bishop (light-space or dark-space) which is trapped on an orthogonally-exited island apart from the one where the target frozen king is located, a bishop can promote into a suitable 6-directional slider at the cost of 2 moves, orthogonally move off any island which is a diagonal trap, approach, line-up with and finally, capture the target frozen king. No exceptions!**

**Ultimately, inconclusive and stagnant endgames (commonly classified by default as draws) are absolutely impossible within royal king games since it is certain that:**

- 1. Even in the most destructive games theoretically possible, mobile material (a minimum of one mobile piece) will be left in one player's hand.**
- 2. With mobile material in hand, a win can be forced every time.**

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## worldview and games

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There is no simple cause-&-effect relationship between the universal game-design principles acquired and refined over time and the 31 individual games in the present collection. In fact, the games in this collection were NOT neatly created as the product of a complete, incisive worldview. Conversely, the games in this collection did NOT suddenly build a complete, incisive worldview.

At the beginning of this project, there was no worldview and there were no games, obviously. Attempts to construct a worldview inspired games one-at-a-time as attempts to construct games inspired single ideas which cumulatively became part of a complex worldview. A variety of desirable and mistaken worldviews and games were a part of the philosophical and experimental process at some moment. Eventually, both an insightful worldview and a catalog of quality games somehow brought each other into existence thru an intercombinative process involving thousands of cross-references and searches for clues between abstract principles and actual, defined games.

Overcoming the inverse relation which normally, inescapably exists between the quantity and quality of the games comprising a collection has been the most labor-intensive aspect of my work by far. Appr. 1000 sketches or designs have materialized into an est. 250 fully-written, published games out of which only 31 have survived my relentless quest for perfection ... thusfar. To be sure, most prolific game inventors have not invested the years in theoretical and experimental work required for it to even be possible that a majority of the games within their collections are of high quality.

Some regard chess variant creation purely as a form of art with as many varying legitimate, equally-meritorious, creative expressions possible as akin to oil painting, for example. Over time, I have grown increasingly skeptical of this view. The numerous, calculable and measurable, mathematical and geometrical qualities intrinsic to ALL chess variants do not exist to be deceptive. Rather, they indicate something important about the basic nature or true definition of chess variants universally. Logically, this compels one to strongly suspect that chess variants, at their best, can only be made in accordance with scientific design principles.

Accordingly, my method in creating and revising games is as mathematical as possible. Games that cannot meet a large number of strict, principled quality criteria and limits are rarely invented in the first place. Furthermore, they must be sufficiently unique and appealing relative to one another. Then, playtesting and critically analyzing the various game features leads to the silent un-invention of some. Those that remain are all well-distilled, the best that I can create.

If I did not limit the number of my creations via a large number of strict, principled quality criteria, then I would be compelled to invest a huge amount of work toward the unworthy goal of creating a theoretically-unlimited number of poor to average games.

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### playing considerations

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Complex tactics and strategies can be built upon the simple foundation of a single, linear move by the staggering number of relevant possibilities and multi-move approaches. The pieces (with their movements) are analogous to simple, moving parts interconnected within a large, complex machine you control, engaged in battle against a large, complex machine controlled by your opponent. In other words, playing these games is comparably fun to ripping your enemy to pieces with a chainsaw as your enemy is ripping you to pieces with a chainsaw. One player is destined to die. The most skillful player is destined to survive albeit barely in many instances. [Please remember these are only games?]

To be sure, all sliding pieces are power pieces. Considerable pressure exists upon both players from the first move of the game. It should not be surprising that games consisting exclusively of sliding pieces are fast, dangerous as well as alarmingly, irreversibly destructive.

The theoretical depth of all 31 games is tremendous, however. So, it would be grossly mistaken to pre-judge any of these games as being recklessly, destructively satisfying yet intellectually worthless. In fact, to such an extreme that playtesting any game to an incisive, instructive depth (12-ply) is currently impossible using anything less than a supercomputer, precariously assuming it could accomplish the task within a survivable time.

Currently, playtesting computer vs. computer games to a minimal 10-ply depth using my fast dual-CPU (2.4 GHz per CPU) server is extremely time-consuming per move per game. A rough estimate of the computer time required to playtest all 31 games comes to at least 5 years. Therefore, I am compelled to postpone this project at least 5-10 years- until the state-of-the-art improves by appr. one order of magnitude.

Due to the unlimited range of the sliding pieces used, offensive and defensive structures often become interconnected with some pieces being used or usable in both ways. Correctly deciding between the various, complex offensive and/or defensive priorities is critically important at numerous moves during a game. Threatening escalations of power pieces frequently occur which trigger forced lines of play unparalleled by other chess variants.

Exclusively offensive or defensive strategies will lead to defeat against a capable opponent. The key to victory lies in being more resourceful than your opponent at handling, balancing both well simultaneously. In a typical, close endgame, the winner is the one who is able to maintain adequate, stable defenses with minimal pieces while freeing up maximal pieces possible to launch effective offenses which overwhelm the defenses of one's opponent.

To prevent one's opponent, esp. if at an obvious disadvantage materially and/or positionally, from having opportunities to force a draw (any one of which may be seized upon) where one's victory is otherwise inevitable, it is vitally important to protect either one's last-only royal piece very well at all times and if at all possible, better than your opponent.

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### human wit vs. artificial intelligence

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Essentially, chess variants are complex, dynamic mathematical machines. As structure defines function, more incisive lines of play progressively approach defining a game itself geometrically thru its best resourceful, holistic, long-range possibilities (i.e., moves) within its characteristic, limited universe- a dynamic, mathematical machine.

In my opinion, great play at chess-related games reaches a level of abstraction where it is difficult to distinguish or correctly attribute the qualities responsible. Science or art, calculation or understanding, knowledge or imagination, logical programming or intuition to survive- which opposite methods or qualities are strongest in our era? Personally, I hope the best chess-related games invented (or yet to be invented) will be ruled by talented humans instead of computers for a while to come.

The Zillions program requires a great amount of time to play the majority of these games reasonably well, the minority of these games badly ... yet many intelligent people can beat it at most games they dedicate themselves to playing.

I welcome thoughtful, constructive correspondence from anyone. Please report or publish any errors or inefficiencies observed or discovered thru playing my games or upon examining their programming (\*.zrf) somewhere on the internet where I will probably see them.

- Derek Nalls