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SECTION 1

INTRODUCTION

This manual assumes that the player already knows the international chess regulations and terminology. If you do not, but wish to enjoy playing 8080 Chess, you can find the basics and rules of the game in a handy Chess Primer in the Appendix of this manual. Or have someone who plays, teach you the basics before reading the manual any further.

8080 Chess is the chess player's genie, the perfect opponent: ready whenever you are, as often as you like, for as long as you want, as difficult to beat as you wish, seldom blundering, never cheating, tireless, patient, attentive.

8080 Chess is a powerful, versatile video display game for S-100 bus microcomputers. The 8080 Chess program was designed and written for Processor Technology by Robert Arnstein of Dallas, Texas. The program has competed successfully in chess tournaments.

Besides playing a regular game as either white or black according to the international chess rules, the 8080 Chess program can be controlled to provide different levels of opposition for players of varying degrees of proficiency. It can be handicapped or play a handicapped player, solve chess problems, continue playing a game saved from a previous time, show you what it is thinking, and how many moves it considered before making its move. It can even provide human spectators with a match between two chess robots.

The 8080 Chess program is contained in a standard CUTS format cassette. The program requires 16K of memory. Once loaded into memory it can be transferred to diskette using a Processor Technology Helios II system.

SECTION 2

LOADING THE CASSETTE

It is suggested that you load the program from cassette before you start reading the manual any further. That way you can see and demonstrate what the manual is referring to.

- 1) Set up the cassette recorder and the video monitor as in the Sol Systems Manual, Operating Instructions, "Monitor and Cassette Recorder Connections."
- 2) Rewind the cassette to the beginning.
- 3) Initialize the SOLOS or CUTER program to the command mode (on the Sol, by pressing MODE SELECT).
- 4) When the system displays the prompt character,
type: XEQ
and press: RETURN

This will load and execute the program if it is the next program on the cassette.

- 5) If 8080 Chess is not the next program on the cassette,
type: XEQ CHESS
and press: RETURN

This will search ahead on the tape for the program, load and excute it.

While loading the program, the tape should be moving for about 2-1/2 minutes. If the program is loaded into memory correctly, the computer will stop the tape and display the initial frame with the chessboard as described in Section 3, The Display. (Refer to Fig. 3-1, The Initial Display.)

SECTION 3

THE DISPLAY

3.1 THE BATTLEFIELD (Refer to Fig. 3-1, The Initial Display.)

The chessboard is displayed on the video monitor as soon as the game is called up. The player's side is always at the bottom of the vertical screen. Each square is identified by means of a simple alphanumeric "road map" coordinate system of notation. (This is called the "algebraic" system of notation.) Counting up from the player's side, the ranks (horizontal rows of squares) are numbered 1 through 8 on both sides of the board. The files (vertical columns of squares) are lettered alphabetically on both the top and bottom of the board reading from the player's left to right: A through H.

For example, the square designated in international notation* as white's R4, is identified as: E4; black's K4 is E5. Note that the letter is always first. Note also that each square has a univocal location; that is, it is the same for black and white; whereas international notation is relative to the black or white side of the board.

3.1.1 Display of the Checkerboard Pattern

If your video is set to display black letters on a white screen, the dark squares will be screened with dark dots. If your video displays white letters on a dark screen, the dark squares will be screened with white dots.

3.2 THE CONTENDERS

UNIMPORTANT NOTE: In deference to the queen as well as to some of the players who may be equal rights advocates, we shall deviate from the international terminology which calls the chess figures collectively "men" and a single piece or pawn a "man". By the way, a "piece" is correctly defined as to exclude pawns.*

*Refer to Appendix 1, Chess Primer, for an explanation of international notation and chess terminology.

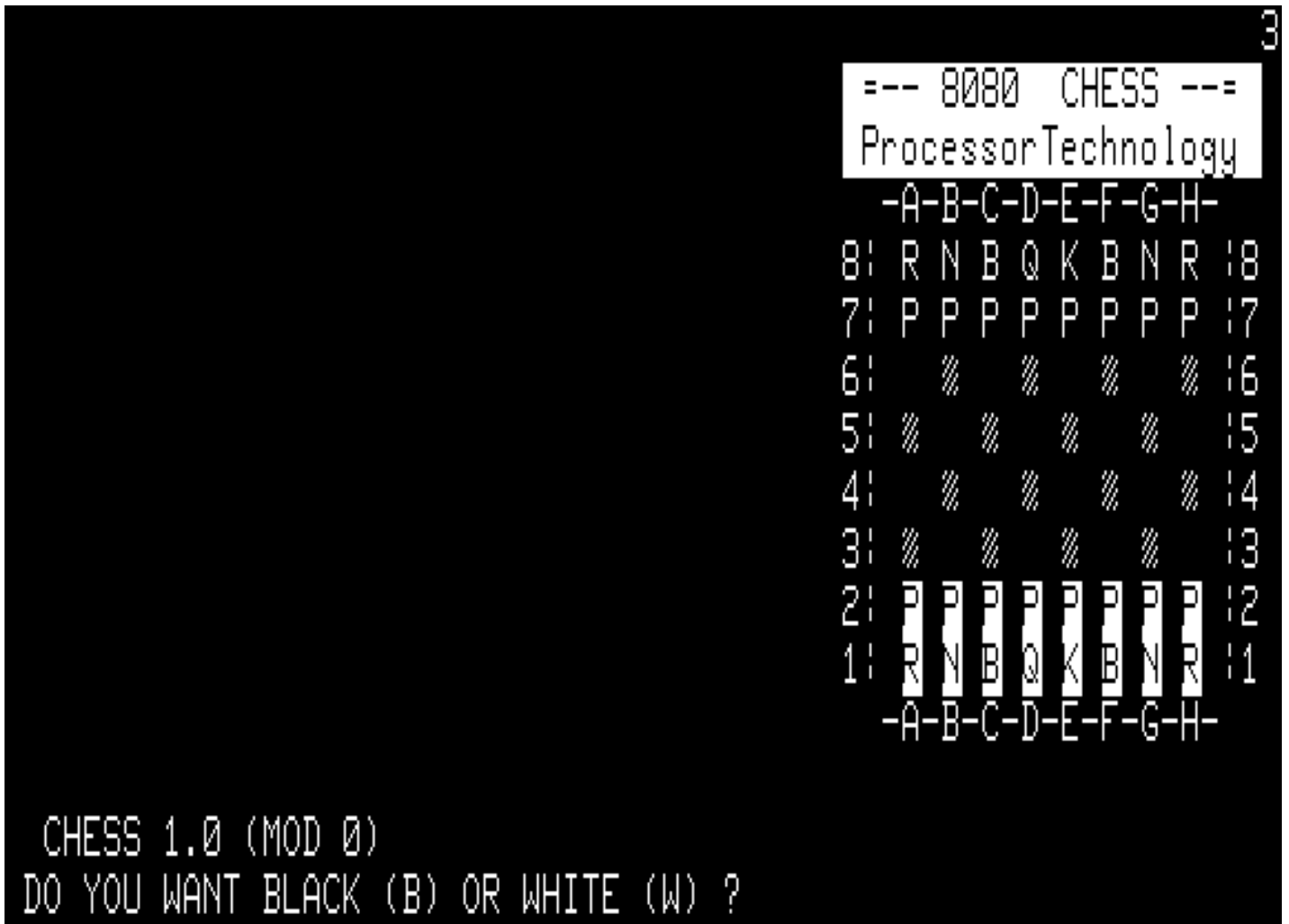


Fig. 3-1. The Initial Display

Each chessperson is represented by a single letter of the alphabet:

Pawn	P
Knight	N
Bishop	B
Rook	R
Queen	Q
King	K

3.2.1 The Complexion of the Chesspersons

If your video is set to display white letters on a black screen (reverse video), the player's persons are displayed as black letters on a white background; the computer's persons are displayed as white letters on a dark background.

If your video is set to display black letters on a white screen (regular video), the player's persons are displayed as white letters on a black background; the computer's persons are displayed as black letters on a white background.

This color-indicating background of a chessperson covers up the display which shows whether the square occupied by the person is light or dark. You can determine whether an occupied square is light or dark by checking an adjoining square which is unoccupied and working back to the occupied square.

3.3 AUXILIARY DISPLAY

As a helpful suggestion, to ease the strain of peering at the economically designed video display, translating the letters representing the persons and interpreting the color of an occupied square, you can set up an ordinary chess board and transpose the moves from the computer display. You can then act out your moves on the real board. This is also an aid in saving games.

3.4 RECORDING THE GAME

The program records the moves in scrolling columns but unlike international notation :

- 1) There is no notation of which chessperson moved.
- 2) There is no notation that a move was a capture.
- 3) A check is noted for computer moves but not for player's moves.

If you want a permanent copy of a game, it would be best to transcribe the moves in standard notation (before they are scrolled off the top of the screen).

SECTION 4

THE MOVES

4.1 DO YOU WANT BLACK OR WHITE?

(Refer to Fig. 4-1, Display of a Game in Progress.)

The program asks this question at the bottom of the screen. If you wish to play white, type: W
and press: RETURN

The program will establish two column headings for the PLAYER and COMPUTER and number the first move: 01.

The chesspersons are already set up for the player using white persons.

If you wish to play black, type: B
and press: RETURN

The displays of the colors of the two sides and the position of the players side will remain the same but the program will reposition the queens to squares of their own color. The computer then immediately makes the first move which it displays on the board and records the notation of the move numbered 01 in the column titled COMPUTER.

4.2 MOVES AND COMMANDS

Simple chess moves such as moving or capturing in the usual manner are entered by typing an alphanumeric code and pressing RETURN. Complex moves such as castling and en passant are executed by commands. Commands are alphanumeric codes preceded by a "circumflex" (^). Not all commands are moves. There are two types of commands: move commands (described in this section) and game control commands (described in Section 5, Chess Problems and Saving Games and Section 6, Game Depth Control and Display.)

Commands may be made only when it is your move. Only move commands replace your regular move. Game control commands are entered when it is the player's move, just before the player's move.

Both moves and commands must be followed by pressing RETURN. The program will acknowledge the RETURN by placing a period after the command.

CHES 1.0 (MOD 0)
DO YOU WANT BLACK (B) OR WHITE (W) ?

	PLAYER	COMPUTER
01:	E2E4	E7E5
02:	G1F3	D7D5
03:	E4D5	D8D5
04:	D2D4	C8G4
05:	F1E2	G4F3
06:	E2F3	F8B4CH
07:	C2C3	E5E4
08:	^CR	E4F3
09:	D1F3	D5F3
10:	G2F3	B4D6
11:		

```

=== 8080 CHES ===
ProcessorTechnology
-A-B-C-D-E-F-G-H-
8: R N  ♔ K ♚ N R 18
7: P P P  ♙ P P P 17
6:   ♘   B   ♗   ♖ 16
5: ♚   ♙   ♘   ♗   15
4:   ♘   ♙   ♘   ♗   14
3: ♚   ♙   ♘   ♗   ♖   13
2: ♙ ♙ ♘   ♗   ♙   ♖ 12
1: R N B   ♗   R ♔   11
-A-B-C-D-E-F-G-H-

```

G2F3.

Fig. 4-1. Display of a Game in Progress

4.3 MOVING TO UNOCCUPIED SQUARES

4.3.1 YOUR MOVE

To move a person to an unoccupied square or to capture an occupied square:

Enter the coordinates of the "from" square (where the chessperson is now) followed by the coordinates of the "to" square (the square to be occupied).

EXAMPLE: If you wish to move: P-K4, type: E2E4
and press RETURN.

Your selected move will be echoed in the display beneath the board and the person will move tentatively to the square selected.

The background of the square will flash alternately white to black (or vice versa). This is your chance to visualize your proposed move and give it final consideration before you commit yourself to it. If you wish to retract the move, press DEL (Delete). The move will be cancelled and you may enter a new move.

If you wish to execute your move, press RETURN a second time. The program will stop flashing the square and will record your move in the record columns.

4.3.2 COMPUTER'S MOVE

The program will begin "thinking" over its own move. A number displayed in the upper right corner of the screen will flash while the program is calculating its move. This number represents the level of the game depth. (Refer to Section 6, Game Depth Control and Display.) When the program has arrived at its move, this number stops flashing, the chessperson is moved on the board, the move is recorded in the move columns, and the number of the next pair of moves is displayed beside the move columns. It's your move again.

4.4 CAPTURING

Moves which capture are entered, displayed, and recorded exactly the same as regular moves as described above (as if the square occupied by the man being captured were unoccupied.)

4.4.1 En Passant*

Capturing en passant is accomplished by entering the command:
^PXNXN RETURN.

Where: P = The code for en passant

XN = (The first XN) The "from" square of the capturing pawn.

XN = (The second XN) The "to" square of the capturing pawn.

EXAMPLE: ^PD5C6 Player's pawn moves D5C6 capturing
 en passant.

4.5 CHECKING A KING

To check the computer's king, simply enter the move as usual. The program will notice if the move results in a check. If the computer's move results in a check, the letters "CH" will be printed alongside the move when it is recorded

4.6 CASTLING

To castle left, enter the command: ^CL RETURN

To castle right, enter the command: ^CR RETURN

CAUTION

The player is not given a "trial" move for castling;
the move will be executed upon the first RETURN.

The player's or the computer's ability to castle may be disabled and then re-enabled. The program begins the game with castling enabled for both player and computer.

The computer's castling may be disabled by the command: ^RC0
(Where R = Rook)

The computer's castling may be re-enabled by the command: ^RC1

The player's castling may be disabled by the command: ^RP0

Re-enable the player's castling by the command: ^RP1

These castling commands are used:

- 1) In continued games which have been reentered.
- 2) In certain chess problems.
- 3) When two computers are to play each other.

*Refer to Appendix 1, Chess Primer, for a glossary of chess terms.

4.7 ILLEGAL MOVES

If the player makes an illegal move, the program questions, "WHAT?" Simply enter a legal move.

CAUTION

If the player inadvertently puts his queen en prise, the program will not give any courtesy; it will promptly annihilate her.

4.8 PROMOTING PAWNS

To promote a pawn about to reach the 8th rank, enter one of the following commands before the move which advances the pawn to the final rank:

Promote to a queen: ^Q5

Promote to a rook: ^Q2

Promote to a bishop: ^Q4

Promote to a knight: ^Q3

4.9 PASSING YOUR TURN TO MOVE

You may skip your move and let the computer move next by entering the command: ^YOU

This command is useful in setting up saved games and chess problems which are covered in Section 5.

4.10 CONCEDING AND REMATCHES

If you would rather not continue a game, you may concede by entering the command: ^X RETURN

If you have conceded, or if you have had the misfortune of having your king checkmated by a merciless machine, the program will offer a rematch. For Yes, answer: Y RETURN

If No, answer: N RETURN

N returns control to SOLOS/CUTER.

SECTION 5

CHESS PROBLEMS AND SAVING GAMES

5.1 SAVING GAMES

The simplest way to save a game that you wish to continue at a later time is:

- 1) Transpose the last position onto a regular chess board or transcribe a diagram of the position onto a piece of paper.
- 2) When you are ready to resume the game, load the game cassette and chose white or black. If you chose black, wait for the computer to move. You can execute commands only when it is your move.
- 3) Use the board positioning command as follows:
^InXXXXXXXX RETURN

Where:

- I = Code for positioning pieces on rank n of the chess board.
- n = The number of the rank to be populated (1 through 8).
- XXXXXXXX = Desired occupants of the 8 squares in rank n given by:
 - Space Bar = Vacant square
 - P = Pawn
 - N = Knight
 - B = Bishop
 - R = Rook
 - Q = Queen

These upper case letters place the computer's chesspersons; to place the player's chesspersons, press the CTRL key simultaneously with the letter key.

- 4) Repeat the positioning command for each rank.

EXAMPLE: To position the ranks given in Appendix 1, Chess Primer, diagram No. 9:

(Where: the computer is black, the hyphens are space-bars, the periods are RETURNS's, and the characters with bars over them are white.)

```
^8-----B-.
^7--P--P̄PR.
^6-----NK.
^5---P̄-----
^4-P----R̄-.
^3-----KNP.
^2--P̄-R---.
^1--NQ--B-.
```

- 5) Enter the castling status.
- 6) Enter the desired depth if different from the default level. (Refer to Section 6, Game Depth Control and Display.)
- 7) Then all the ranks are set, and if it was your move when the saved game was adjourned, make your move now. If it was the computer's move, skip your move using the command: ^YOU

5.2 SETTING UP CHESS PROBLEMS

Set up the problem as if it were a saved game as in Section 5.1 above, giving the mating side to the computer.

5.3 HANDICAPPING

Use the positioning command to add or substitute chesspersons as desired on either your side or the computer's, until you feel you are matched satisfactorily with the skill level of the program.

SILLY EXAMPLE: See how long it takes you to beat the program with a rank of queens instead of pawns.

Or you might disable the computer's castling.

NOTE: The depth to which the computer analyzes its moves can be set to a smaller value to accomodate beginners. (Refer to Section 6.)

SECTION 6

GAME DEPTH CONTROL AND DISPLAY

6.1 SETTING THE STRENGTH OF THE COMPUTER'S GAME

The strength of the computer's move is determined by the "depth control." The program automatically plays at a depth control setting of 32 (pronounced "three/two"). The value of the first digit is the number of half-moves ahead that the program will analyse its potential moves. A half-move is one move by either the player or the computer. A half-move is referred to as a "ply."

The value of the second digit is the number of additional plys the program will analyze upon finding a capture by either side.

The value of these two parameters can be set independently to either raise or lower the depth setting. The higher the numbers, the stronger the computer's move will be. The lower the numbers, the weaker an opponent the computer will be. Note that for each additional ply added to the first parameter, the time taken by the computer to reply increases approximately by a factor of 30!

6.1.1 Instructions for Setting the Depth Control

The depth command (and other commands) may be entered only when it is the player's move, and before the player moves.

To set the search depth, enter the command: `^Dnm RETURN`

where D = The code for DEPTH search.

 n = The depth, a digit in arabic numbers 1 through 9.

 m = Added depth upon finding a capture by either side, expressed as a digit, 1 through 9. If m = U (DIU), capture depth is unlimited.

CAUTION

There is no way of knowing how long the computer will take to move if the capture depth is set to U.

EXAMPLE: `^41 RETURN`

A depth of 4 ply plus one additional capture ply for a total of 5 ply on captures.

Maximum finite setting is 99. Maximum setting is 9U. Minimum setting is 11.

NOTE

The next subsection, 6.1, is provided for those who are interested in the theory of operation of computer chess programs. It is not necessary to read this subsection in order to play the game. Instructions for setting the depth control are in the previous subsection, 6.1, Setting the Strength of the Computer's Game.

6.2 HOW THE PROGRAM FINDS ITS MOVE

Much like a human chess master, the program arrives at its move by considering its available moves, the resulting positions, and the subsequent moves possible for each resulting position, and so on. A diagram of the relationships of the positions of a chess game is called a search tree or look-ahead tree. (Refer to Fig. 6-1, Look-ahead Tree.) (A search tree actually has only one root and grows downwards, with each lower level being much broader than the higher, like a pyramid.)

The positions in the tree can be represented as circles (called nodes) and the moves as lines branching from the positions. At the starting position at the top of the tree, it is the computer's move. For the sake of example, in Fig. 6-1, only three moves are shown available from the starting position.

The starting position could be in the opening, the middle game or end the game. In the example, the program calculates a possible move 1 and its resultant position, node 1. If the position is favorable according to certain criteria in the program, it scores the node with a higher score and stores it in its memory; if the position is unfavorable, it scores the node with a lower score. The program then evaluates the node resulting from move 2, and also gives it a relative score. It does the same to node 3. Some of the moves it may reject out of hand on principles stored in the program. When it has considered all the moves available from the starting position, the level of positions is called "ply 1," the program could be said to have analyzed the look-ahead tree to a "depth" of one ply. Actually this is only a preliminary survey on the part of the program.

On the average there are about 30 moves available at each position in a game. Each of these 30 moves has 30 replies and so on. Since human life is very brief and most of us have other things to do besides play chess, the program must be set to search the tree of possible moves to a fixed depth. 8080 Chess has a depth control accessible to the player. Upon initialization it comes up with a preset default value of 31 (three/one) which provides a good game to a player who is better than average.

The ply level at the limiting depth is called the terminal ply; the positions represented at the limiting depth are called terminal nodes. A complex of nodes propagating from the same ply 1 parent node is called a branch. A chain of nodes connected together within a branch with only one node in each ply is called a string. If a string ends in node at a ply higher than the terminal ply, then that node is the terminal node for the string.

The program grows the tree one branch at a time to the depth assigned to it and evaluates the terminal nodes found on the branch, giving a score to each terminal node, as is shown in Fig. 6-1. The score is lower proportionate to the advantage it gives the player and higher proportionate to the advantage it gives the computer.

The program gives the player the benefit of the doubt by assuming the opponent will find and take his or her best move. Therefore the program takes the score of the terminal node having the lowest score and assigns it to the parent-node connected to it on the next higher ply. Looking horizontally on the new ply level, it takes the minimum score of all the terminal nodes on that branch and assigns it to the parent-node on the next higher ply. It continues backing up the tree from node to parent-node until the node at the first ply has the minimum score found in searching the terminal nodes branching from them.

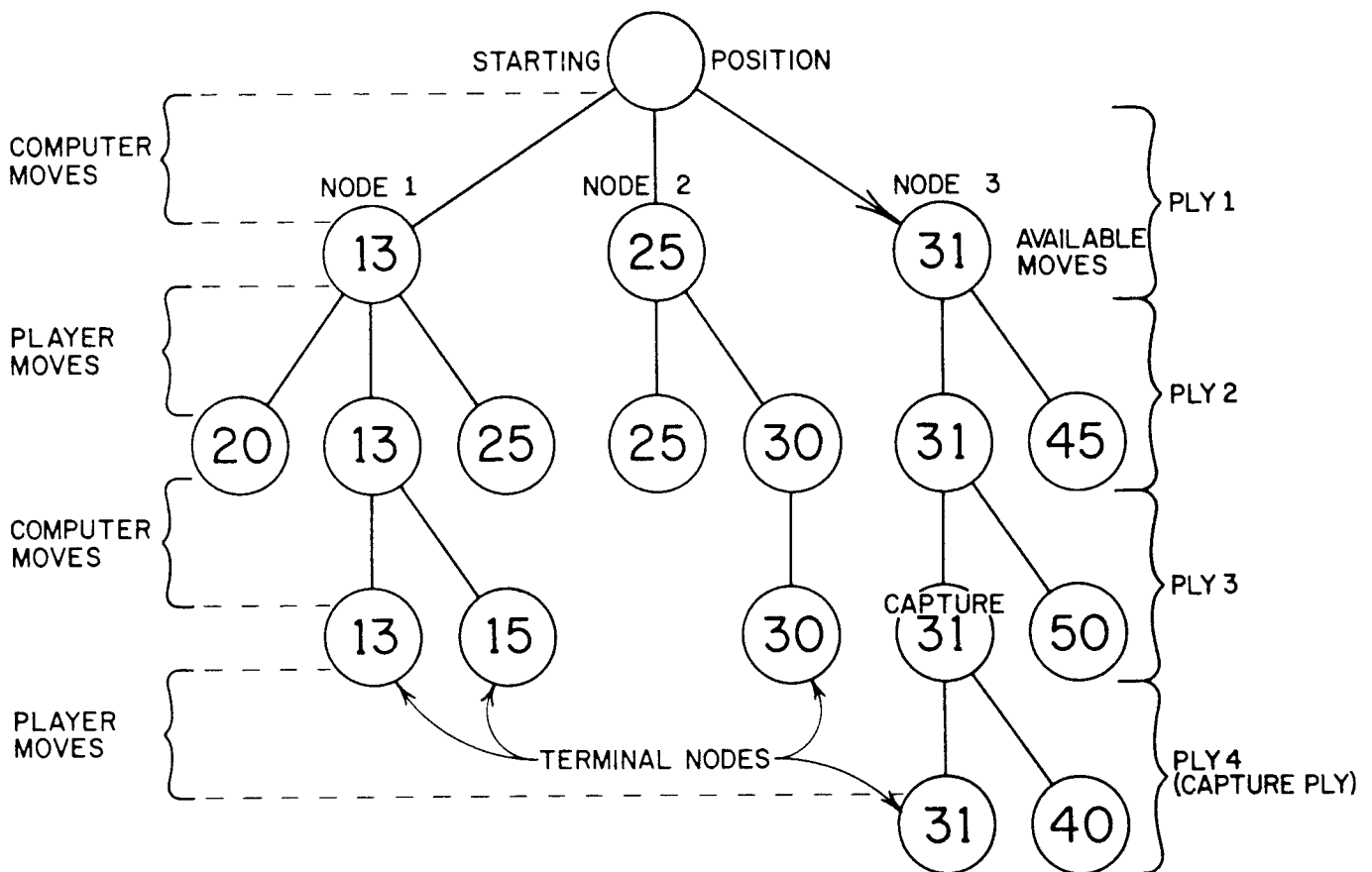


Fig. 6-1. Look-ahead Tree

When each of the initial positions on ply 1 has received its score, the program selects the move leading to the node having the highest score. In Fig. 6-1, therefore, the program chooses the third move as indicated by the arrow leading from the starting position. This method of tree searching is called the minimax method.

6.2.1 SETTING THE DEPTH OF THE TREE SEARCH

The program is preset to a tree search depth of 32. This is not "thirty-two" but "three/two." With this setting the computer will move on the average in 2 to 3 minutes having analyzed up to about 15,500 nodes maximum. With each ply the number of nodes analyzed is roughly 30 times the number analyzed on the previous ply. This exponential increase with each ply of search added means also an exponential increase in time taken by the computer to run the search. For example, a depth setting of 44 takes the Sol about 2 to 3 hours per move. Therefore, unless you are Rip VanWinkle or have access to a time machine or a Cray 2 computer which emulates an 8080, it would behoove you to be careful when setting the search depth.

For instructions for setting the depth control, refer to subsection 6.1.

6.3 SEARCH DISPLAYS

6.3.1 A Penny for Your Thoughts, Computer

To see what the computer is thinking when it performs the evaluation its move, enter the command: ^S RETURN
(Commands must be entered during the player's move. A game control command does not replace your move.)

The display shows the possible moves being acted out. The speed of the display may be controlled by the number keys, 1 through 9. Key 1 is the fastest speed at which the display can be shown; key 9 is the slowest. Remember that the search display will slow down the actual calculations, consequently increasing the time the computer takes for its moves. To turn off the display, repeat the command during any of the player's subsequent moves. (This type of command is called a "switch.")

6.3.2 How Many Nodes Did You Consider That Move?

By means of another game control command, the hexadecimal equivalent of the number of terminal nodes analyzed by the program after each of its moves can be displayed. The number is displayed in a little box which appears in place of the number 8080 of the initial display. Refer to Fig. 4-1, Display of a Game in Progress.

To display the number of terminal nodes analyzed, just before you make your next move, enter the command: ^E RETURN
To turn off display, repeat the command during any subsequent player's move. (Switch)

A 4-digit hexadecimal number representing the decimal number of terminal nodes appears in a box in the upper right area of the display. The hex number is converted to decimal as follows:

DIGIT POWER: 16³ 16² 16¹ 16⁰
(DECIMAL FACTOR: 4,096 256 16 1)

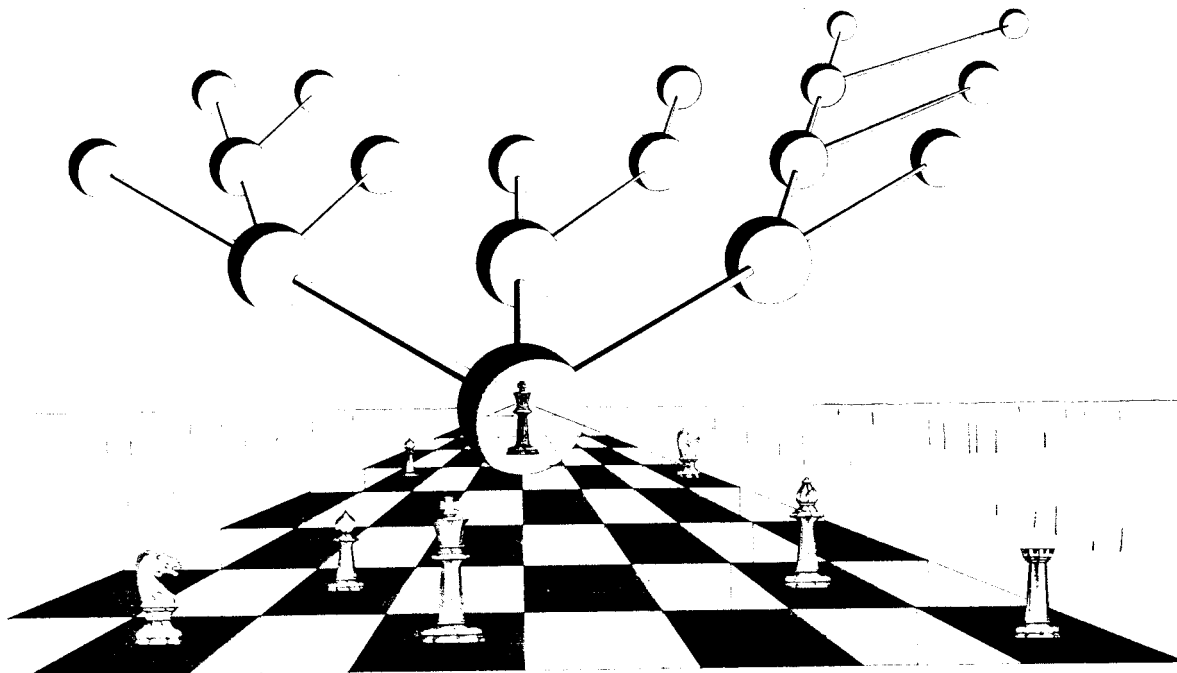
HEX NUMBERS: 0 1 2 3 4 5 6 7 8 9 A B C D E F
DECIMAL: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

INSTRUCTIONS: Multiply the decimal equivalent of each digit position by the factor for that position and add the results.

EXAMPLES:

1111 (hex) = 4,096 + 256 + 16 + 1 = 4,369 nodes.

FFFF (hex) = 61,440 + 3,840 + 240 + 15 = 65,535 nodes.



SECTION 7

CHESS ROBOTS PLAY EACH OTHER

Two Sols can play each other communicating through their EIA serial interface ports. Use the following procedure:

- 1) Connect the J1 Serial Communication Interface connectors of the two Sols with a 3-conductor cable wired as follows:

<u>Sol 1</u>		<u>Sol 2</u>
Pin 7	to	Pin 7
Pin 2	to	Pin 3
Pin 3	to	Pin 2

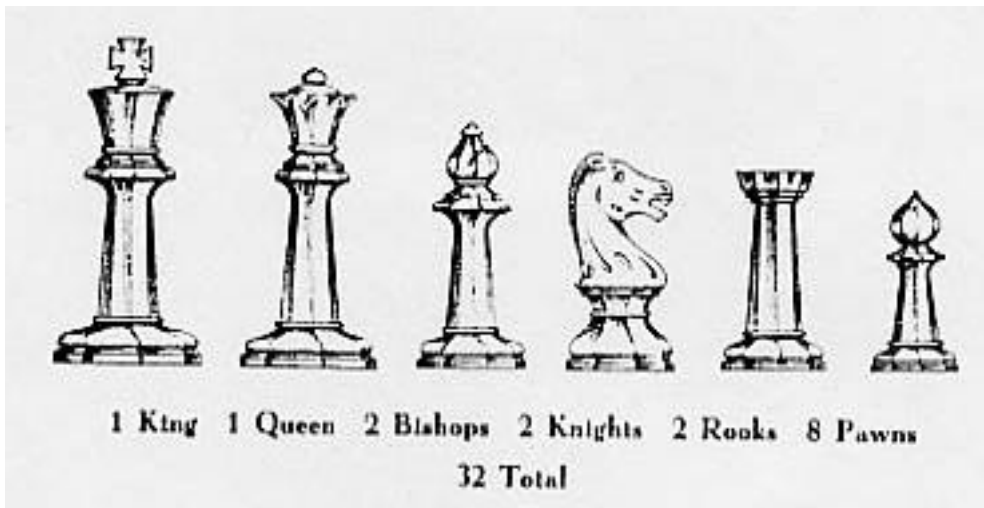
- 2) Enter B (Black) on first Sol.
- 3) Enter W (White) on second Sol.
- 4) Set desired depths.
- 5) Disable castling of both Sols; otherwise the program will be lost when the first Sol castles. (The program is weighted to castle at the earliest opportunity after it has developed the opening for the computer in which it resides.)
- 6) Set displays as desired. Once the game is started, the computers will not respond to commands.
- 7) Enter ^Z RETURN on first Sol. It should say "What?"
- 8) Enter ^E2E4 RETURN on second Sol. The game will commence. The first Sol displays itself as the "computer" and the second Sol as the player. The second Sol displays itself as the computer and the first Sol as the player. Therefore, since the player's position is always at the bottom of the screen, each display will be the reverse of the other.

APPENDIX 1

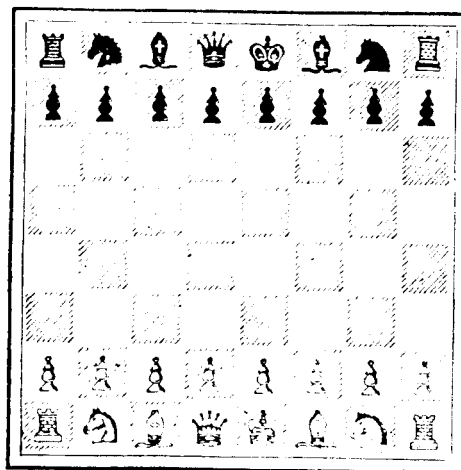
CHESS PRIMER*

CHESS is a game in the play of which there is no element of chance. It is played on a square called the chess board and divided into 64 squares colored light and dark alternately.

Each player shall play with a series of sixteen men, one series to be light colored and called white, and the other to be dark colored and called black. The men in each series consist of:



The men shall be arranged on the chess board at the opening of the game as shown in diagram No. 1.



No. 1

*Reprinted from Cruoke's Chess Primer, published by Wm. F. Druke & Sons, Grand Rapids, Michigan, U.S.A.

The symbols used on this and following diagrams represent the different pieces respectively as follows:

	White King		Black King
	“ Queen		“ Queen
	“ Rook		“ Rook
	“ Bishop		“ Bishop
	“ Knight		“ Knight
	“ Pawn		“ Pawn

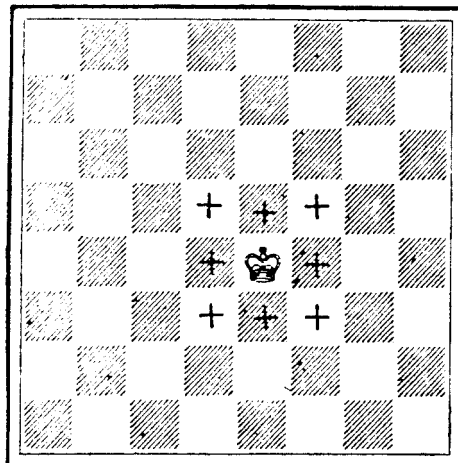
The men move to unoccupied squares excepting in making a capture. Then they take the square vacated by the captured man. The Knight is the only piece having the power to move over an occupied square. The two exceptions to these rules, taking a pawn en passant, and castling, will be taken up later in paragraphs explaining the moves of the King and the Pawn.

The board shall be so arranged that each Player shall have a white square in his right-hand corner. The Player and the Opponent shall play alternately one move at a time. The person whose turn it is to move is termed the Player and the other is termed the Opponent.

A capture is effected by removing the Opponent's man from the board and replacing it with the capturing man. All captures are optional except when necessary to avoid checkmate. The condition of checkmate or mate occurs when the King, being at the time in check (attacked by a hostile piece or Pawn), cannot be relieved from that condition.

THE KING

The KING can be moved to any square adjoining the square he occupies, and captures in the same manner any unprotected opposing man. In the following diagram (2) the spaces marked with a cross indicate the squares to which the King may move.



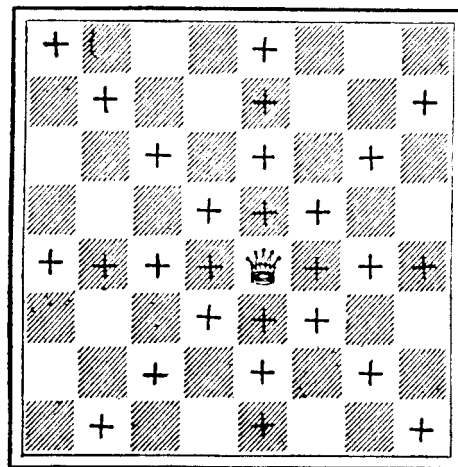
No. 2

Once during each game both the Player and the Opponent have the privilege of castling, that is moving the King two squares either to the right or left and placing the Rook toward which he moved on the square over which the King has passed. Castling can be consummated only when there are no intervening pieces, when the King is not in check (that is, being attacked by a hostile man), and only when neither the King nor the Rook have previously moved. The King must never move over a square commanded by an opposing man.

The King is the most important piece as the loss of the King means the loss of the game. In the opening and middle game the King has but little offensive power due in part to the circumscribed nature of his move, and also to the risk of involving him in unnecessary danger. In the end game, however, the King becomes a potent force for both offense and defense. The novice should always remember that while the opening moves are primarily for the development of the pieces, and though he should avoid premature attacks, he must constantly be on guard against such strategy against his own King. Except in cases of necessity it is seldom advisable to move the King early in the game. If for no other reason, this is true because it abrogates his right to castle.

THE QUEEN

The QUEEN moves and captures on the rank, the file and the diagonal in any direction and over any distance over unoccupied squares. In the following diagram (3) the spaces marked with a cross indicate the squares to which the Queen may move.



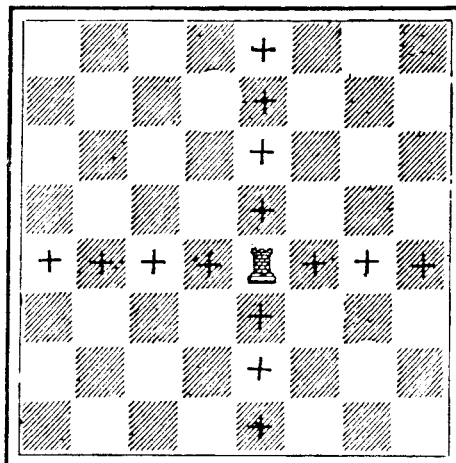
No. 3

The Queen is the most powerful of the pieces, possessing the combined powers of the Rook and Bishop. While the mobility of the Queen makes it a very useful and powerful piece at any stage of the game, still the player should guard against allowing it to be drawn out unnecessarily into positions from which it cannot be readily retracted.

The player should also always guard against allowing his Queen to be pinned, that is, caught between his own King and an inferior attacking piece in such manner that his Queen may not move and escape capture.

THE ROOK

The ROOK moves and captures in the rank and file only, over unoccupied squares. In the following diagram (4) the spaces marked with a cross indicate the squares to which the Rook may move.



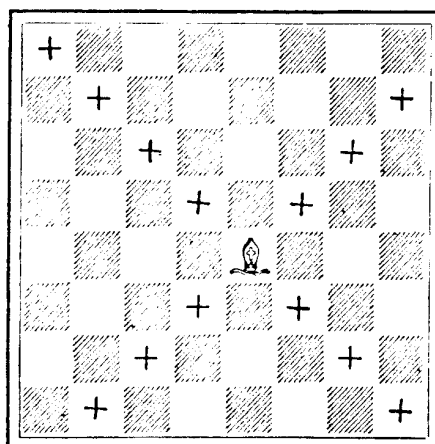
No. 4

The Rook is next to the Queen in power and due to its original position hemmed in by its own pieces is seldom brought into play in the early stages of the game. Since the Rook in conjunction with the King takes part in the joint move known as castling, it is well not to move the Rook until the player is sure he does not want to castle on that side.

When through the exchange of Pawns a file becomes "open," that is, not obstructed by Pawns, it is often well to take command of the file with one of the Rooks.

THE BISHOP

The BISHOP moves and captures diagonally in any direction over unoccupied squares. In the following diagram (5) the spaces marked with a cross indicate the squares to which the Bishop may move.

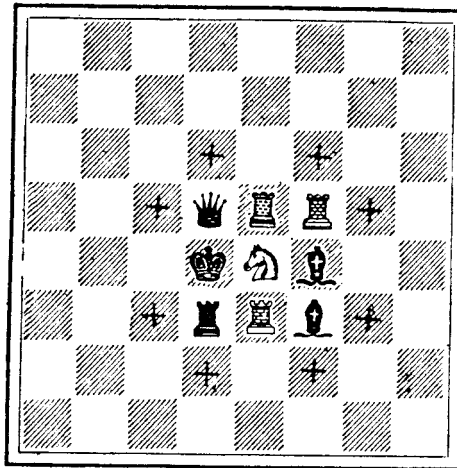


No. 5

The Bishop is next to the Rook in power. The two Bishops are originally placed on squares of different colors, and throughout the game move over and to squares of the same color.

THE KNIGHT

The KNIGHT moves and captures in any direction by a movement combining the moves of the Rook and the Bishop. That is, it moves one square like a Rook, then like a Bishop one square, which final square must not adjoin the square from which the Knight is moved, such movements constituting one move. Thus it will be seen that the Knight moves to the farthest corner of a rectangle composed of six squares, and always moves to a square of the opposite color to the one on which it started. In the following diagram (6) the spaces marked with a cross indicate the squares to which the Knight may move.



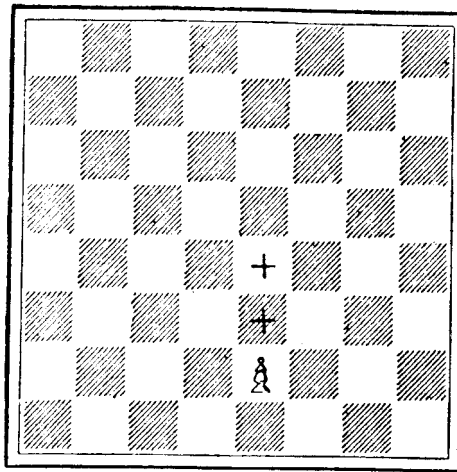
No. 6

The Knight is next to the Bishop in power. The difference, however, is very slight and some players prefer to a single Knight to a single Bishop. Two Bishops, however, are much stronger than two Knights if only for the reason that two Bishops and a King constitute a mating force.

THE PAWN

The PAWN moves forward only, and excepting for its first move, only one square at a time. Each Pawn for its first move has the privilege of moving two squares at the option of the player. The Pawn is the only man that does not capture as it moves. It captures on either of the two diagonal squares adjoining it in front. Each Pawn that is moved to a square on the eighth rank must be exchanged for a Queen, Rook, Bishop or Knight of the same series without regard to the number of such pieces already on the board.

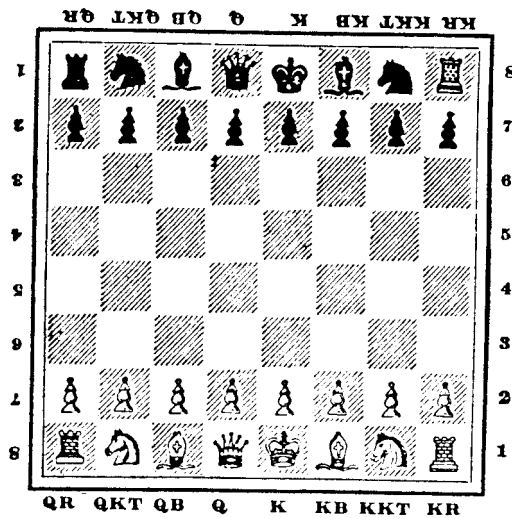
A Pawn which has been moved two squares on its first move is liable to be captured on the following move by a Pawn that could have captured it, if it had moved only one square, precisely as though it had so moved. (This is called "En Passant.") In the following diagram (7) the spaces marked with a cross indicate the squares to which the Pawn may move.



No. 7

THE NOTATION

Both of the two most widely used system of notation are recognized by the F.I.D.E.,* the Descriptive and the Algebraic. Because of the almost universal usage of the descriptive system in books published in the English language we will confine ourselves to that system. The men except the Knight are designated by their initials, and the Knight by Kt, or by N, if preferred. The Bishop, Knight and Rook on the King's side of the board are, if necessary, further designated by prefixing the letter K and the corresponding men on the Queen's side by prefixing the letter Q. The Pawns are designated by prefixing the initial of the piece on whose file they stand.



No. 8

*Federation International Des Echecs

The eight files counting consecutively left to right on the side of the chess board initially occupied by the white men are designated the QR, QKt, QB, Q, K, KB, KKt, and KR files respectively.

The eight ranks are numbered for the white men 1 to 8 from the side of the chess board initially occupied by them, and inversely for the black, 1 to 8 from the side of the chess board initially occupied by

them. Thus referring to diagram 8, the black Rook in the upper right-hand corner is on the King's Rook's eighth square, or on KR8 reading from the white side of the chess board and is on the King's Rook's first square or on KR1 reading from the black side.

A move shall be recorded by the letter designating the man moved, followed by the letter or letters and number designating the file the file and rank respectively of the square to which the man has been removed. For instance, Q - KB4 means the Q is moved to the fourth square of the file of the King's Bishop. When two men of the same series and denomination can be moved legally to the same square, the letter or letters and number designating the file and number of the square which the moved man occupied shall be added in brackets to the letter designating the man moved. For instance R (Kk2) - Kt4 means the R on the second square of the Kk file is moved to the fourth square of the same file.

If an opposing man occupies the square to which a man is moved, the designation of such opposing man shall be substituted for the designation of the square, preceded by the symbol for capture, but the latter designation, stated as from the Player's side of the Chess board, shall be added in brackets if otherwise the record could be interpreted as applying to more than one opposing man.

The following abbreviations will be found in common usage in Chess literature and should be memorized by the student:

Castles KR or 0--0	Castles with the KR (Short Castling).
Castles QR or 0--0--0	Castles with the QR (Long Castling).
X	Captures.
Ch	Check.
Mate	Check and Mate.

VALUE OF THE CHESSPERSONS

Taking the worth of a pawn as unity, the following is an estimate of the comparative mobility value of the persons:

Pawn	1
Knight	3
Bishop	3.25
Rook	5
Queen	9.5
King	2.5

(Of course, the King cannot be valued for trading because he is the object of the game.)

TECHNICAL TERMS

EN PRISE - A piece is said to be en prise when it can be taken by a hostile piece or Pawn.

J'ADOUBE or I ADJUST - Used to inform the opponent that a piece is being touched for the purpose of adjustment and not with the intention of moving it.

FORCED MOVE - When a player has only one move at his disposal it is termed a forced move.

ILLEGAL MOVE or FALSE MOVE - Any move which cannot be legally made, such as castling after the King has been moved or moving a Knight like a Rook.

MINOR PIECES - The Bishops and Knights are termed minor pieces to distinguish them from the Queen and the Rooks.

RANKS AND FILES - The rows of horizontal squares are called ranks and the rows of vertical squares are called files.

GAMBIT - A word derived from the Italian, meaning to trip up in wrestling. The word as used in chess phraseology signifies a sacrifice, usually a Pawn sacrifice, for the purpose of obtaining an attack. The Pawn thus sacrificed is called the "gambit" Pawn.

DOUBLED PAWN - Pawns of the same color on the same file are called doubled Pawns.

ISOLATED PAWN - A Pawn which cannot be supported by other Pawns and stands alone on a file is called an isolated Pawn.

PASSED PAWN - A Pawn is called "passed" when there is no hostile Pawn to prevent its march to the eighth square.

MAN - A term applicable to each King, Queen, Rook, Bishop, Knight and Pawn.

PIECE - A term applicable to each man except a Pawn.

PINNED MAN - A man that occupies a square between the King of the same color and an opposing piece that would otherwise be giving check to the King.

DISCOVERED CHECK - Check given to the Opponent's King when the line of action of the checking piece is opened by the movement of another man of the same color.

DOUBLE CHECK - Check given by the man moved in addition to the discovered check from another piece.

AN EXCHANGE - The exchange by capture of identical men, or of men of practically the same theoretical value.

SMOTHERED MATE or Philidor's Legacy occurs when the King is so hemmed in by his own men that he cannot move out of check from a hostile Knight which is the only piece that can administer this mate.

CHECKMATE - This word is derived from the Persian "Shah mat," literally: "the King is dead." This occurs when the King at the time in check is unable to relieve himself from this condition.

TO TAKE "EN PASSANT" OR IN PASSING. When a Pawn exercises his privilege of moving two squares on his initial move, an opponent's Pawn situated on the fifth square of an adjoining file may capture it by moving onto the square over which the Pawn has moved, just as if he had stopped there.

DRAWN GAME - When neither Player can checkmate his adversary, the game is drawn. The following are the instances in which this occurs:

a. When the player cannot make a legal move and the King is not in check, the King is then said to be stalemated.

b. If the Player proves he can subject the Opponent's King to an endless series of checks.

c. By reoccurrence of position when the same position occurs three times in the game, and the same person is Player on each occasion, and if such Player claims the draw before the position is altered by further play, otherwise no claim can be sustained. (For the purpose of this clause there shall be no distinction between the King and Queen's Rooks and Knights, or between the original pieces and pieces of the same denomination and color obtained through the promotion of Pawns.)

d. By mutual agreement, but only after 30 moves have been made with the Black men.

e. The game shall be declared drawn if the Player proves that 50 moves have been made on each side without checkmate having been given and without any man having been captured or Pawn moved.

f. Either the Player or the Opponent may at any period of the game demand that the other checkmate him in 50 moves (subject to the conditions attached in (e).) If checkmate is not given in 50 moves, the game shall be declared drawn. Nevertheless, the count of 50 moves shall begin again after each capture of any man and after each movement of a Pawn. Exception shall be made for certain positions where theoretically more than 50 moves are necessary to force a checkmate and in this case, a number of moves double the number established by theory as being necessary for this object shall be allowed in lieu of the 50. The draw must be claimed by either the Player or the Opponent immediately when the stipulated number of moves in Conditions (e) and/or (f) of the particular case is completed without checkmate being given, and not at any later period.

g. Lack of Force of pieces remaining do not constitute sufficient force to checkmate the opposing king.

THE LAWS OF CHESS

THESE LAWS were passed by the F.I.D.E. (Federation International Des Echecs) during a meeting of the council at Venice in July, 1929. They are from the authorized edition of the official code as translated by the British Chess Federation in 1931.

1. THE POSITION OF THE CHESS BOARD AND THE MEN

The chess board shall be so placed between the two persons that the nearest corner square at their respective right hands shall be light colored. If in the course of, or immediately after a game, it be proved that the initial position of the men on the board was incorrect, or the chess board wrongly placed initially, the game shall be annulled.

If in the course of a game the number or position of the men be altered illegally, the position immediately before the alteration occurred must be reinstated and the game resumed therefrom. If this position cannot be ascertained, the game shall be annulled and there shall be a replay.

2. THE MOVE

The choice of playing the first game with the white men or the black men shall be determined by lot, or by agreement, and in a match of two or more games the two persons shall play with the two series alternately, irrespective of the results of the games, but games annulled according to the above law shall not be reckoned in applying this rule.

The first move shall be with the white men, and thereafter the players shall move alternately, one move at a time.

3. TOUCHING MEN

If the player touch:

1. one of his own men he must move it,
2. one of his opponent's men he must take it,
3. one of his own men and one of his Opponent's men, he must take the latter with the former, if such capture be a legal move. If not, the Opponent may require either that the player shall move the man touched, or take with any one of his men, at the Player's option, with which the capture can be effected legally, the Opponent's man touched. If none of the moves indicated in this paragraph can be made legally, no penalty can be exacted.

4. ILLEGAL MOVES

If a Player makes an illegal move and the Opponent draws his attention to the fact before touching any of his own men, the illegal move must be retracted and the game shall be continued as follows:

(a) When a capture has not been made, the Player shall make a legal move with the man he has moved illegally, but if no such legal move can be made, no penalty can be exacted.

(b) If a capture has been made, the Player must either take the Opponent's man by a legal move, or make a legal move with his own man touched at the option of the Opponent, but if no such legal move can be made, no penalty can be exacted.

(c) If in the course of a game it is proved that an illegal move has been made and not retracted, the position existing immediately before the illegal move was made shall be reinstated and the game shall be continued from that position. If the position cannot be reinstated the game shall be annulled.

5. PENALTIES

The Opponent can exact a penalty for an infraction of these laws only if he has not touched one of his own men after the infraction occurred. Castling cannot be exacted as a penalty move. If the Opponent names as penalty a move which is illegal, his right to exact a penalty for the illegality committed by the Player shall be abrogated. Before enforcing any penalty the position which existed before the illegality occurred shall be reinstated.

6. CASTLING

The person who gives the odds of a Rook may castle as though this Rook were on the board, on the side from which the Rook has been removed, object to the condition that this Rook's square is not occupied by any other man of either series.

7. PAWN TAKING "EN PASSANT"

If a Player be left with no other move than to take a Pawn in passing, he must make that move.

8. GAMES FORFEITED

The game shall be declared forfeited by the Player or the opponent who:

(a) Wilfully upsets the board or disarranges the men.

(b) Refuses to comply with a legal requirement under these laws.

(c) In the course of a game refuses to conform to the arrangements and to obey the rules made for the conduct of the game.

(d) Whether present or absent exceeds any time limit for the consideration of his moves.

9. THE UMPIRE OR BYSTANDERS

A dispute on a question of fact may be submitted by agreement of the Player and Opponent to the decision of a disinterested bystander, in which case his decision shall be binding without the right of appeal.

10. When putting the Opponent's King in check, it is customary but NOT obligatory, for the Player to advise the opponent of this fact by saying "check."

11. COMPLETION OF MOVE

A move is complete:

(a) In moving from one square to another, when the Player has quitted the man.

(b) In capturing, when the captured man has been removed from the Board and the Player has quitted the man making the capture.

(c) In Castling, when the Player has quitted the Rook.

(d) In promoting a Pawn, when the Player has replaced the Pawn by the selected piece and quitted the latter.

OPENING

IN A BOOK of these proportions, we have not the space to present an exhaustive analysis of the many openings in current use. We do, however, desire to give an example of a few of the more common opening moves.

The only pieces available on the first move are the Knights. In order to develop the other pieces it is necessary to move the Pawns first. Since quick development is of prime importance, it is well first to move such Pawns as will give outlet to the greatest number of pieces. There are not many developing Pawn moves to choose from, and for the purpose of this book we shall confine ourselves to a few of the openings that start with moving either the King's or the Queen's Pawns.

1. THE CENTER GAMBIT

	WHITE	BLACK
1.	P - K4	P - K4
2.	F - Q4	P x P
3.	Q x P	Kt - QB3
4.	Q - K3	Kt - B3
5.	Kt - QB3	B - K2
6.	B - Q2	P - Q4

2. THE KING'S-BISHOP'S OPENING

1.	P - K4	P - K4
2.	P - Q4	P x P
3.	B - QB4	Kt - KB3
4.	P - K5	P - Q4

3. THE SCOTCH GAMBIT

1.	P - K4	P - K4
2.	Kt - KB3	Kt - QB3
3.	P - Q4	P x P
4.	B - B4	Kt - B3
5.	P - K5	P - Q4

4. THE SCOTCH GAME

1.	P - K4	P - K4
2.	Kt - KB3	Kt - QB3
3.	P - Q4	P x P
4.	Kt x P	Kt - B3
5.	Kt - QB3	B - Kt5
6.	Kt x Kt	KtP x Kt
7.	B - Q3	P - Q4

5. GIUOCO PIANO

1.	P - K4	P - K4
2.	Kt - KB3	Kt - QB3
3.	B - B4	B - B4
4.	P - B3 or P-Q3	

6. THE RUY LOPEZ

1.	P - K4	P - K4
2.	Kt - KB3	Kt - QB3
3.	B - Kt5	

7. THE FRENCH DEFENSE

1.	P - K4	P - K3
2.	P - Q4	P - Q4
3.	Kt - QB3	Kt - KB3
4.	B - Kt5	P x P
5.	B x Kt	P x B

8. QUEEN'S GAMBIT

1.	P - Q4	P - Q4
2.	Kt - KB3	P - K3
3.	P - B4	P x P
4.	Kt - B3	Kt - KB3
5.	B - Kt5	B - K2
6.	P - K4	P - KR3

9. QUEEN'S GAMBIT DECLINED

1.	P - Q4	P - Q4
2.	Kt - KB3	P - K3
3.	P - K3	P - QB4
4.	P - B4	Kt - QB3
5.	Kt - B3	Kt - B3
6.	QP x P	B x P
7.	P - QR3	P - QR3
8.	P - QKt4	B - Q3
9.	B - Kt2	Castles

ILLUSTRATIVE GAME

AS AN illustrative game we present the following famous masterpiece which was played by Morphy against the Duke Karl of Brunswick and Count Isouard in the Royal box at the Paris opera house.

WHITE	BLACK
1. P - K4	1. P - K4
2. Kt - KB3	2. P - Q3
3. P - Q4	3. B - Kt5
4. P x P	4. B x Kt
5. Q x B	5. P x P
6. B - QB4	6. Kt - KB3
7. Q - QKt3	7. Q - K2
8. Kt - B3	8. P - B3
9. B - KKt5	9. P - Kt4
10. Kt x P	10. P x Kt
11. B x KtP ch	11. QKt - Q2
12. O - O - O	12. R - Q1
13. R x Kt	13. R x R
14. R - Q1	14. Q - K3
15. B x R ch	15. Kt x B
16. Q - Kt8 ch	16. Kt x Q
17. R - Q8 mate	

PROBLEMS

THERE IS one branch of the art of chess that while not as popular as the cross board game, is still worthy of our consideration. That is the chess problem. A chess problem consists of a position on the board somewhat like an end game. The pieces are arranged in such a way that a checkmate is possible in a given number of moves. Usually the white men are to checkmate the black.

There may be many variations due to the lines of defense adopted by the black men, but if it be a good problem there can be but one first move that will bring about the desired results.

The illustrative problem that we have selected is not a difficult one to solve, but will serve as an example of what constitutes a chess problem, and may give the reader an evening's enjoyment.

WHITE	BLACK
K on KR8	K on KR7
Rs on KKt7 and Q2	Q on KKt7
B on QR7	B on KR8
Kt on KKt1	P on KR5

White to move and mate in two moves.

APPENDIX 3

ABOUT CASSETTE RECORDERS AND CASSETTE FILES

Successful and reliable results with cassette recorders and cassette files require a good deal of care. You need to use consistent and careful methods, and you need to know what to expect, when you try to read a manufacturer's tape, or your own. The following methods are recommended:

- 1) Use only a recorder recommended for digital usage. For use with the Processor Technology Sol or CUTS, the Panasonic RQ-413AS or Realistic CTR-21 is recommended.
- 2) Keep the recorder at least a foot away from equipment containing power transformers or other equipment which might generate magnetic fields, picked up by the recorder as hum.
- 3) Keep the tape heads cleaned and demagnetized in accordance with the manufacturer's instructions.
- 4) Use high quality brand-name tape, preferably low noise, high output tape. Poor tape can give poor results, and rapidly wear down a recorder's tape heads.
- 5) Bulk erase tapes before reusing. It can be hard to find the file you want in a jumble of old file pieces. Bulk erasing also decreases the noise level of the tape.
- 6) Keep cassettes in their protective plastic covers, in a cool place, when not in use. Cassettes are vulnerable to dirt, high temperature, liquids, and physical abuse.
- 7) Experimentally determine the most reliable settings for volume and tone controls, and use these settings only.
- 8) On some cassette recorders, the microphone can be live while recording through the AUX input. Deactivate the mike in accordance with the manufacturer's instructions. In some cases this can be done by inserting a dummy plug into the microphone jack.
- 9) If you record more than one file on a side, SAVE an empty file, named "END" for example, after the last file of interest. Once you read its name, you will know not to search beyond it for files you are seeking. One way to avoid having to search for files is to record only one file per cassette, at the beginning of the tape, if you can afford the extra cassettes.

- 10) Do not record on the first or last minute of tape on a side. The tape at the ends gets the most physical abuse. Do not be impatient when trying to read the first file on a tape. You, or the manufacturer of a pre-recorded program, may have recorded a lot of empty tape at the beginning.
- 11) Record a file more than once, before it leaves memory. This redundancy can protect you from bad tape, equipment malfunction, and accidental erasure.
- 12) Most cassette recorders have a feature that allows you to protect a cassette from accidental erasure. On the edge of the cassette opposite the exposed tape are two small cavities covered by plastic tabs, one at each end of the cassette. If one of the tabs is broken out, then one side of the cassette is "write protected." An interlock in the recorder will not allow you to press the record button. A piece of tape over the cavity will remove this protection.
- 13) Use the tape counter to keep track of the position of files on the cassette. Always rewind the cassette and set the counter to zero when first putting a cassette into the recorder. Time the first 30 seconds and note the reading of the counter. Always begin recording after this count on all cassettes. Record the beginning and ending count of each file for later reference. Before recording a new file after other files, advance a few counts beyond the end of the last file to insure that it will not be written over.
- 14) The SOLOS/CUTER command CATalog can be used to generate a list of all files on a cassette. In SOLOS/CUTER, type CAT <CR>, rewind to the beginning of the tape, and press PLAY on the recorder. As the header of each file is read, information will be displayed on the screen. If you have recorded the empty file called END, as suggested, you will know when to search no further. If you write down the the catalog information along with the tape counter readings and a brief description of the file, you will be able to locate any file quickly.
- 15) Before beginning work after any modification to the system, test by SAVEing and GETting a short test program. This could prevent the loss of much work.

In addition to using the above procedures methodically, you need to know the various ways in which programs may be recorded on tapes you have purchased:

- 1) If you cannot read a file consistently, and suspect the tape itself, do not despair. The same file may have been recorded elsewhere on the tape. Processor Technology often records a second version, later on the same side of the tape. When you first get a tape, CATalog it with SOLOS or CUTER so you will know exactly what it contains. Write down the tape counter readings at the same time.

2) An empty file named END is sometimes placed at the end of the recorded portion of a tape. When SOLOS CATalogs a file, the file header information is displayed as soon as the beginning part of the file passes the tape head, but nothing is displayed when the end of the program passes by. If another filename such as END is displayed, you know you have just passed the end of the previous file.

3) Some of the programs supplied by Processor Technology contain a checksum test within their code, in addition to the checksum test which SOLOS performs. When a program containing this test is first executed after loading, the checksum test reads all of the program in memory, and calculates a checksum number which is compared with a correct value. If the numbers match, the program in memory is correct. Nothing is displayed when the numbers match, but if they do not match, the message CHECKSUM TEST FAILED, or a similar message, is displayed. The message may be followed by two numbers, representing the correct and incorrect checksum numbers.

Even though the checksum test was failed, it may be possible to enter the program anyway by typing the carriage return key. The bad data may not even be apparent, if it is in a portion of the program you do not use. It is best, however, to try to find and correct the problem causing the error so the checksum test is passed. The error can be caused by the cassette interface circuitry, bad memory locations, bad tape, a faulty recording, improper alignment or settings on the cassette recorder, or other equipment problems.

APPENDIX 4

MOVE AND COMMAND SUMMARY REFERENCE

(Commands are preceded by a circumflex (^) Press RETURN to enter all typed moves and commands.)

MOVES AND MOVE COMMANDS

To select white, enter: W RETURN

To select black, enter: B RETURN

To enter a move, enter: $\underbrace{\text{LetterNumber}}_{\text{From Square}} \underbrace{\text{LetterNumber}}_{\text{To Square}}$

EXAMPLE: P-Q4 with player as white is D2D4

^CL Castle Left.
^CR Castle Right.
^YOU Player skips a move and lets computer move.
^PD5C6 Capture En Passant from D5 to C6.
^X Resign.

GAME CONTROL COMMANDS

^RP0 Disable player's castling.
^RP1 Enable player's castling.
^RP0 Disable computer's castling.
^RC1 Enable computer's castling.
^Q5 Next Pawn reaching 8th rank will become a Queen.
^Q2 Next Pawn reaching 8th rank will become a Rook.
^Q4 Next Pawn reaching 8th rank will become a Bishop.
^Q3 Next Pawn reaching 8th rank will become a Knight.

^InXXXXXXXXX Position computer's persons on rank n of board.
Where X= one of the following:

P=Pawn, R=Rook, Q=Queen, B=Bishop, N=Knight,
K=King, Space-bar=Vacant.

To position player's persons, press CONTROL simultaneously while entering the character representing the person.

^Dnm Set depth to n, added capture depth to m.

EXAMPLE: ^D34 =3 ply plus 4 more ply on captures
(7 ply on captures)
If m=U (EXAMPLE: ^D3U)), capture depth is unlimited.

^S Display search. (Switch)

^E Display number of end nodes looked at (in hex) (Switch).

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Please enter the following changes into your manual. The changes are keyed to the Section of the manual in which they occur.

4.6 CASTLING

When two computers are being set up to play each other, disabling their castling is no longer necessary. The computers will castle when ready and will continue playing.

On page 4-4 of the manual, Section 4.6, delete the second line from the bottom: "3) When two computers are to play each other."

5.1 SAVING GAMES

On page 5-2, in the example at the top of the page, insert the letter "I" between the circumflex (^) and the number of the rank on each rank. For example, the eighth rank is: ^I8-----B-.

6.1.1 Instructions for Setting the Depth Control

On page 6-1, in the example, insert the letter "D" between the circumflex (^) and 41. The example is: ^D41 RETURN

6.2 HOW THE PROGRAM FINDS ITS MOVE

In the second paragraph from the bottom of page 6-2, change "...preset default value 31 (three/one)..." to "preset default value 3/2 (three/two)..."

On page 6-3, delete the last sentence of the first paragraph.

Delete the second paragraph and Fig. 6-1. Make a note to refer you to the substitute text and diagram which follow.

On page 6-4, delete the first paragraph.

SUBSTITUTE TEXT (for Section 6, pages 6-3 and 6-4):

A negative score is assigned if the position represented by a node favors the player. A positive score is assigned if the position favors the computer. Positions are evaluated on the basis of material and positional advantage. In Fig 6-1, the depth is set to 3/2, or a total of 5 ply when a capture is found; on the third ply or when a check occurs. The program evaluates the branches springing from the ply 1 nodes one at a time, starting from the terminal nodes, which are at the lowest ply of the branch. From the terminal nodes, the program works backwards up the tree to the starting position.

If the terminal node of a branch results from a player's move (as occurs on even-numbered plies) the program assumes the player shall have chosen his or her strongest move on the previous ply; therefore the program takes the score of the terminal node having the lowest and backs this score up to the next higher ply, assigning the score to the parent-node which represents the position from which the player would move. If the terminal node is a position resulting from the computer's move (as occurs on odd-numbered plies) naturally the program chooses the highest scoring terminal node and assigns the score to the terminal node's parent node which represents the position from which the computer would move.

This tree search method of alternately choosing minimum or maximum scores depending on whose move it is, is called the "minimax" method.

After backing up the score of the terminal nodes to the next higher ply, the program, looks horizontally on the new ply and evaluates the other nodes belonging to the same branch, if any. Then it continues backing up the tree, using the minimax method, until the initial node on ply 1 has been evaluated. Then it examines the next branch in the same manner. When each of the ply 1 nodes has been scored, the program is now back to real time. Since it is the computer's move, the program chooses the ply 1 node with the maximum score. In the example presented by Fig. 6-1, the heavy arrows point out a path through the branch which the program has selected for its proposed development.

SECTION 7

On page 7-1, delete step 5).

In step 8), insert a "Z" between "^" and: E2E4. The command is:
^ZE2E4

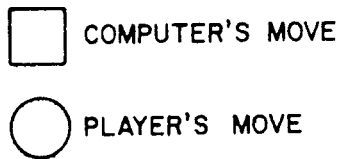
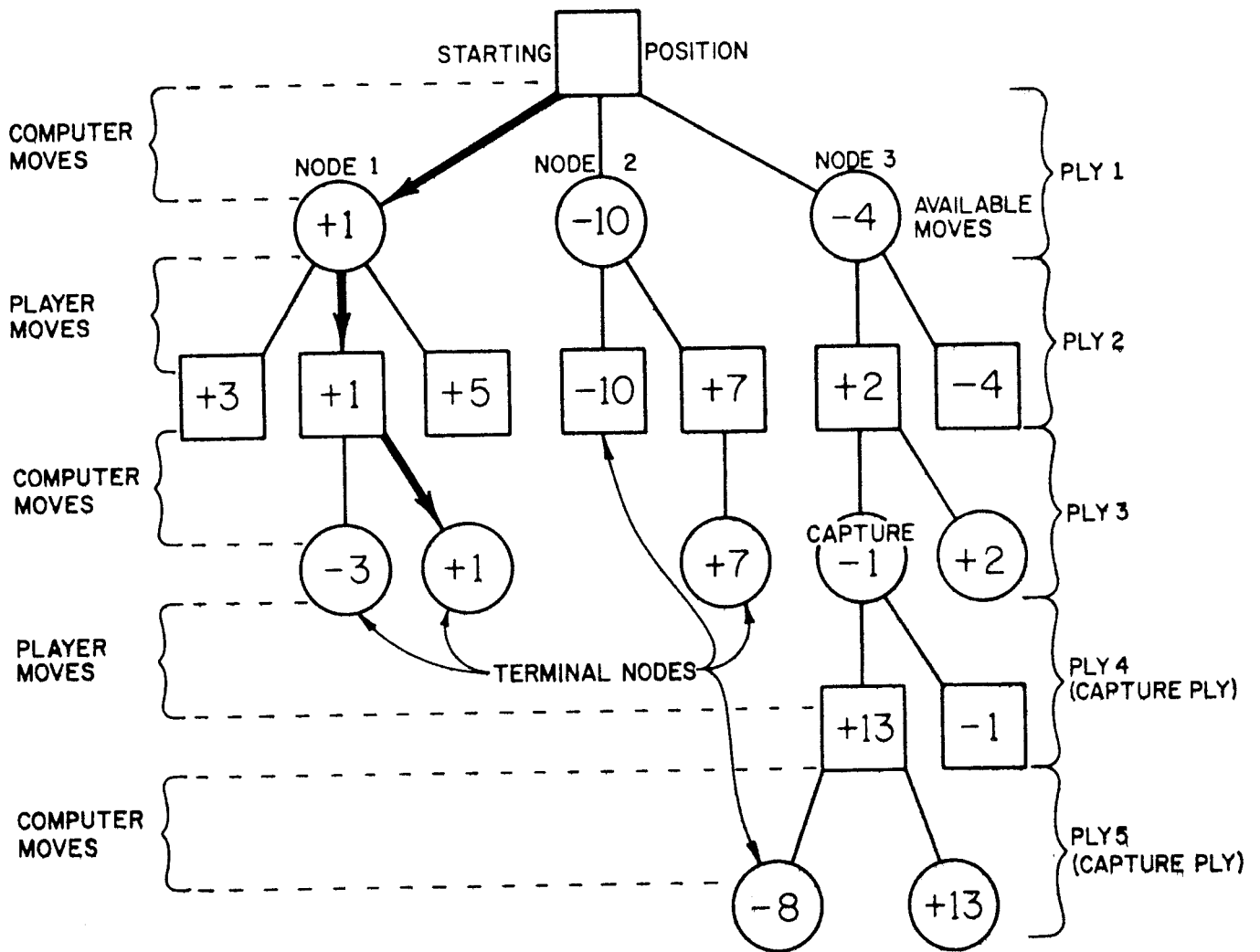


Fig. 6-1. Look-ahead Tree