Chess Computers

A critical descriptive analysis of the currently available commercial chess computers.

DANNY KOPEC

During the past few years, computer professionals and laypeople alike have often asked me: "How well do chess computers play? Can you beat them?"

The answer to the first question is entirely relative—it depends on what you mean by well. The United States Chess Federation (U.S.C.F.) rating scale is divided into eight categories called classes, spanning 200 points each (see Table 1). The best commercial chess computers are rated in the 1900s, putting them high in Class A—below the Experts but above good club players, who might be rated around 1700 (Class B), and in with the top high-school-team players. The top-rated chess program is the former World Champion BELLE (authored by Ken Thompson and Joe Condon of Bell Laboratories), which was the first program to receive a Master rating (2203) at the last World Computer Championship in New York City in October 1983. BELLE has, on occasion, beaten human masters in serious tournament play (at the international level, human chess is played at a rate of 40 moves in 2½ hours, while in national tournaments the rate of play is slightly faster, perhaps 40 moves in 2 hours or 30 moves in 1½ hours).

The answer to the second question is yes. Being rated 2410 by the World

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Chess Ratings

HUMAN CONTESTANTS:
Bobby Fisher
Gary Kasparov, highest-rated (2715)*
Anatoly Karpov, World Champ (2705)*

International Master or
U. S. Senior Master
Danny Kopec, (ABACUS author) (2410)*

OUTSTANDING CHESS PROGRAMS:
BELLE (2195)
CRAY BLITZ (2148)

COMMERCIAL CHESS COMPUTERS:
SUPER CONSTELLATION (Novag) (2018)

Top-of-the-line Fidelity products:
ELITE A/S, PRESTIGE, ELEGANCE,
DELUXE SUPER 9
CONSTELLATION 3.6 (Novag)

Middle-line Fidelity, Novag, SciSys products
MEPHISTO

GREAT GAME SYSTEM (Applied Concepts)

Low end of the market (miniature products)

Early products like CHESS CHALLENGER 10

*World Chess Federation ratings.
A Short History

Since the first chess computers were developed and marketed about eight years ago, the industry has undergone several important developments to meet consumer demands and to try to get ahead of the competition. The early products, such as CHESS CHALLENGER I, COMPUCHESS, and BORIS, played very poorly, and had extremely awkward input facilities. Standard chess rules including castling, *en passant*, and under-promotion abilities were not available. Manufacturing quality control was also very bad, but buyers were generally eager enough to overlook this. Despite high prices and poor service, there were customers. But only one of the original companies has retained a strong role in the industry since its beginning: Fidelity Electronics (now called Fidelity International), the manufacturer of the CHESS CHALLENGER series. Early products such as Fidelity's CHESS CHALLENGER 10 (successor to the CHESS CHALLENGER 1) and Applied Concepts' BORIS, costing $250 to $300 and highly publicized, actually played little better than 1100 chess.

The market really boomed at last in 1979, when Fidelity introduced the CHESS CHALLENGER 7 for under $120. This was Fidelity's most successful product ever, with a total of 600,000 sold. Around 1980 a number of competitors appeared on the market, often making exaggerated and even false claims of master-level products. The strongest product at the time was SARGON 2.5, programmed by Kathe and Dan Spracklen and designed by Applied Concepts with the help of Chafitz Inc. This software product was available for the Apple 2 and TRS-80 computers, and played roughly 1650 chess. SARGON 2.5 developed into two distinct, stand-alone chess computers: the Modular Game System (from Applied Concepts) and the Auto Response Board (manufactured by AVE Microsystems). Both played at a 1500 rating, some 300-400 points better than their predecessors.

The concept of modularity, meaning that a consumer can buy the main product and then continually upgrade it by adding improved and inexpensive modules, has never lived up to its promise. The upgrade modules have been slow to get into production, are not cheap ($100-150), and have not produced convincingly stronger play. Such modules as the

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**Table 1.** The U.S.C.F. rating system and current positions of chess computers on it. Classes on the United States Federation rating scale are represented in terms of 200-point-spans such as 1600–1799 (Class B), 1800–1999 (Class A), 2000–2199 (Expert), and 2200–2399 (Master). International Masters normally obtain ratings of around 2400, Grandmasters near 2500, and super Grandmasters (the world's top 20) around 2600. The World Champion, Anatoly Karpov, is rated 2705—and his challenger Gary Kasparov is rated highest at 2715—on the World Chess Federation scale (which gives a somewhat lower rating for a player than the U.S.C.F. scale).
CAPABLANCA (for endings) and STEINITZ (the more recent and essentially complete game cartridge), while appealing in principle, could cost over $100 total (even in 1984), and guaranteed no better play than a present-day $200 product. Other companies such as SciSys, Novag, and Conchess have also delved into modularity without notable success. At present, the more popular and successful cartridges are those for improved and extensive opening play (some, for example, nearly comprising the complete five volumes of the Encyclopedia of Chess Openings). Also quite popular are printer or clock attachments for recording play.

In 1980, although Fidelity had about 90% of the U.S. market and about 30% of the remaining worldwide market, no one was doing much to improve the quality of play. Instead, gimmicks like the VOICE CHALLENGER, which could announce the moves played, were introduced. There was little progress between 1980 and early 1982 in terms of playing strength. But in late 1982, with the appearance of such products as Fidelity's ELITE, SciSys's MARK V, and Hegener and Glaser's MEPHISTO II, there was a quantum leap of some 100 to 200 rating points, reaching the vicinity of the Class A (1800) level.

A major factor which determined Fidelity's continued success was the hiring of the Spracklens (a husband-and-wife team) as their programmers. Since that time, their products have been continuous leaders in terms of strength, playing features, and economical pricing. Although Fidelity has yet to produce a machine officially rated over 2000, it has maintained a leadership position in a fast-changing and demanding industry across the top, middle, and low end of the market line. So while several competitors fell by the wayside, including Conchess and Applied Concepts, Fidelity was almost without competition in America from 1980 (its best year, with a wholesale turnover of some $40 million worldwide) until late 1983. In 1983 Fidelity had about 50% of the market outside the U.S., and in 1984 maintained about 75% of the U.S. market.

Main Products of the Past Two Years

While the original article in the Summer 1985 issue dealt in detail with the main products of the past two years and presented a large comparative tabulation, this editor-cut version only takes up those at the top and bottom of the line.

Current Top-of-the-Line Products

The two top-of-the-line chess computers available (as of March 1985) in terms of playing strength, features, and price are Fidelity’s ELITE A/S—hereafter referred to as ELITE—and Novag’s SUPER CONSTELLATION, listing at $600 and $400 respectively.
The SUPER CONSTELLATION, a product which made its appearance on the commercial microcomputer market in the fall of 1984, recently became the first microcomputer program rated "Expert" (1988). This rating was established via forty games against humans organized by the newly-established U.S.C.F. Computer Rating Agency. Its rating puts SUPER CONSTELLATION among the top 11% of U.S. chess players. The rating of the most recent version of ELITE (A/S-C, which is 4.0 MHz over A/S-B's 3.0 MHz) is estimated to be just over 2000 as well. A comparison of these two programs across a number of features appears in the panel on page 251.

One of SUPER CONSTELLATION's special features is that it can checkmate with bishop and knight, playing at five seconds per move—something beyond the capability of many strong human players below the master level, even at tournament time controls. In general, SUPER CONSTELLATION knows more about the end game than other programs, including important pieces of information such as the "square of the pawn," the idea that rooks belong behind passed pawns, etc. Its middle-game play is enhanced by about 160 instructions devoted to chess knowledge and standard positional or tactical themes. About 75% of these instructions encourage active play for particular types of positions, while the remaining 25% attempt to prevent errors.

Fidelity's ELITE comes with a 55-page owner's manual which describes its numerous possible modes of operation and playing features. There are 39 squares, with special functions including the setting of eight levels for average response time, different types of search, mate-solving, and voice controls, among others. The ELITE has an "experimental chess" mode whereby the type of search it is to employ—iterative or noniterative—can be specified and viewed. In the iterative mode, the program first decides on the type of position it is in (tactical or positional) and what specific routines it must use (such as special-purpose subroutines for pawn endings). An ordered move list is determined according to material and positional scores for every move at every ply depth. The search continues until a predetermined depth has been reached. The noniterative (depth-first type) search will analyze each of the moves from the initial position to a set depth after these moves have been sorted by the positional analysis. It is easy to see how the ELITE can be a useful experimental computer-chess tool.

The Third World Microcomputer Chess Championship (a seven-round, Swiss System† event held in Budapest, Hungary, 13–19 October 1983) was won by the ELITE, with a score of 6 points out of a possible 7. There were eighteen entrants from eight countries, with six commercial companies represented by fourteen of the eighteen entries. This was the third time in as many World Microcomputer Chess Championships that a Fidelity product won, and the undefeated ELITE distinguished itself with a very large, specially prepared opening book, characteristically solid and cautious play based on material gain, and some luck against Novag's
FIDELITY-X versus NOVAG-X

The following game was the third-round showdown between FIDELITY-X (a prototype of the ELEGANCE just prior to its release) and NOVAG-X (a prototype of the SUPER CONSTELLATION just prior to its release last fall) at the Canadian Computer Chess Invitational Championship (cccic) 1984, which took place 27-29 July 1984 at McGill University’s School of Computer Science. FIDELITY-X won the tournament with a 5-0 score, while NOVAG-X scored 3-2 for third place in a field of three academic and three commercial entries.

Here you find all one could ask for from a game of chess, including some very interesting opening play by FIDELITY-X (black), middlegame complications in which NOVAG-X misses a chance to mate in 7 ply by sacrificing a rook, and finally a protracted end game. The main features of the play illustrate very well the strengths and weaknesses of present-day chess computers, particularly the need for a more pattern-based approach and the importance of knowledge and goals in the end game. The annotations appeared in the September 1984 issue of the ICCA Journal, and later in Volume #70 of En Passant, the Canadian chess publication.

White: NOVAG-X
Black: FIDELITY-X
Queen’s Gambit Accepted
1  d4  d5
2  c4  dxc4
3  Nf3  Nf6
4  e3  e6
5  Bxc4  c5
6  0-0  a6
7  Qe2  b5
8  Bb3  Bb7
9  Rd1  Nbd7
10 Nc3  Qb8

Up to here and white’s next move, the play is in both programs’ books.

In fact, the game SCHACH 2.7. vs. FIDELITY-X (WCCC, New York, 1983) reached this position when white played 11 d5 and the game continued: 11 . . . exd5 12 Nxd5 c4 13 Nxf6+ Nxf6 14 Bc2 Bc5 where black is not worse. For a full annotation of that game, see Computer Chess Digest Annual 1984, pages 68-9.

Around 1930, in the heyday of Alekhine, this opening was a very popular choice for black. It is solid and reliable if black plays carefully.

11  a3  Bd6
12  h3  0-0
13  Bc2  b4?!
—a double-edged move whereby black truly tries to wrestle the initiative by depriving the WN of its control of d5 and e4, at the expense of relinquishing the a4 and c4 squares to white and giving him a half-open a-file. I would prefer . . . Re8 or . . . Rd8.

14  axb4  cxb4
15  Nbl
—the best square in order to redevelop from d2 to c4 or support the advance e4.

15 . . . Bxf3?!
A surprising move, in that it trades off black’s best piece. Still recommended is . . . e5 or . . . Re8.

16  Qxf3  Rc8
17  Bd3  a5
At this point NOVAG-X tried to play 17 . . . e5, and it was discovered that up to this move in the game, it did not think that there was a BR on a8. This move probably had not affected any of its moves so far, and thus they were “replayed” to this position but with a BR on a8. In the meantime, Sidney Samole adjusted FIDELITY-X’s internal time-clock to account for this time out. This played an important role later in the game.

18  Nd2  a4
19  Nc4  e5?!
I would have preferred . . . Bc7, pre-

To be continued
serving the bishop and preparing... e5. The text is very provocative.

20 Nxd6 Qxd6
21 dxe5 Qxe5
22 Bd2 Rab8

An unusual position in that black is still better, despite having given up his bishops cheaply. If 23 Rxa4, then 23... Nc5 24 Ra5 Qxb2 is very good for black.

23 e4 Qxb2
24 Bf4 Ra8

Black could now transpose into a comfortably winning end game with 24... Ne5; e.g., 25 Bxe5 Qxe5 26 Rxa4 b3, etc.

25 Qe3 Nc5
26 Rab1 Qa3
27 Be5

—a critical position, with the BQ displayed offside. White's bishops offer good attacking chances in any case, but black's best defense is probably

27... Nfd7.
27... Nxd3
28 Rxd3 b3?

Here the regroupment of the BQ (even at the expense of a good connected passed pawn) is absolutely essential; i.e., 28... Qa2 29 Rxb4 Qe6, etc.

29 Bxf6 Qa2 [see diagram]
30 Rbd1

Suddenly white has a win but misses it. After 30 Qg5, white soon forces mate. [see note on p. 258.]

30... Qa3

—the only defense. If 30... gx6, 31 Qh6 wins.

31 Qg5 Qf8
32 Qh6

To be continued
Fancy, but not effective. Better and more consistent was 32 Rg3 g6 33 Bd4 when white should win.

32 ... Rc6
33 Rg3 g6
34 Qxf8 +

Now white should definitely not exchange queens (34 Qf4), as his chances of mating black are greatly diminished.

34 .... Rx£8
35 Bg5 Re8
36 Re3 b2
37 Red3 Rb6
38 Rb1 Rxe4
39 Rd8 + Kg7
40 Be3

Neither side has played best for the past few moves. Now, however, FIDELITY-x, which had 10 minutes for its last three moves to time control, has 3½ minutes left on its real clock to make its 40th move. This tight time situation was probably a result of an error in the internal schedule, which Mr. Samole had reset earlier when NOVAG-X discovered that it had no black rook on a8.

The suffering and expressions of the two Samole brothers before FIDELITY-x, finally made its 40th move—with just 30 seconds left—were no less than those of a chess player in a tough game. This scenario and the position where NOVAG-X missed a forced mate were worth paying to see.

40 .... Rb3
41 Bd4 + f6
42 f3 Re2
43 Rd5 Rc2
44 Kh2 a3
45 Ra5 Rc1
46 Rxa3 Rxa3
47 Rxb2 Rc6
48 Kg3 Ra4
49 Be3 h5

—a worthwhile space-gaining pawn advance. However, black's subsequent locking of the K-side pawns is a bad idea.

50 Rd2 Rac4
51 Rd8 h4 +
52 Kf2 Rc2 +

53 Bd2 Kf7
54 Ke3 Ra2

Better would be 54 ... Rb2, followed by 55 ... Ke7 and 56 ... Rd6, whereby black wins quickly.

55 Kd3 Rcc2
56 Ke3 Ke6
57 Bd4 g5
57 ... Ra6 and ... Rd6 still wins quickly by forcing the exchange of rooks.

58 Rd3 f5
59 Rd4 Ke5
60 Rd3 f4 +

Now, by the rules of the tournament, the game could have been adjudicated (a win for black). However, Fidelity sportingly agreed to play on to the next control at move 80 to try to demonstrate the win.

61 Ke2 Ke6
62 Rd8 Rab2
63 Kd1 Ke5
64 Rd3 Kf5
65 Bc3 Ra2

Here 65 ... Rxc3 and 66 ... Rxf2 wins easily.

66 Bd2 ke6
67 Rd8 Rcb2
68 Ke1 Ra1 +
69 Ke2 Ra6
70 Kd1 Rc6
71 Re8 + Kf6
72 Rd8 Rcc2
73 Rd6 + Ke7
74 Rd5 Ke6
75 Rd8 Ra2
76 Ke2 Kf5
77 Kd1 Kf6
78 Rd7 Ke6
79 Rd8 Rcb2
80 Ke1 Ke7

Although FIDELITY-x, has not demonstrated any progress during the last 20 moves, the game was now adjudicated as a win for black. The winning plan after 81 Rd5 starts with ... Ra6 followed by ... Rd6, and black can make steady inroads while offering the trade of rooks. White eventually runs into Zugzwang. Ironically, NOVAG-X as black is able to find the plan (81 ... Ra6) but goes astray later.
NOVAG-X and SUPER CONSTELLATION, both of which had winning positions against it but “overlooked” three-fold repetitions. The Fou  World Microcomputer Chess Championship was held in Glasgow, Scotland in September 1984, and ended in a four-way tie among FIDELITY-X, MEPHISTO-X, PRINCESS-X (Sweden), and PSION (England), each with 5 points out of a possible 7 points, in a field of nineteen competitors. A number of commercial participants entered more than one product; Novag did not participate.

Which is the stronger, ELITE or SUPER CONSTELLATION? Dan Spracklen recently told me that in a twenty-game match between an experimental ELITE and an off-the-shelf SUPER CONSTELLATION, played with tournament time controls (40 moves in 2 hours) in his laboratory, with each playing 10 whites and 10 blacks, and no opening library, ELITE obtained a score of +6 (11 wins, 5 losses, and 4 draws). It is important to bear in mind that a computer chess program’s success against another program does

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Features of the SUPER CONSTELLATION and ELITE

- Appearance. The SUPER CONSTELLATION is very similar to the CONSTELLATION in terms of unit size (12” x 9¾”) and has a neat, modern look. However, the ELITE, with its inlaid wooden sensory board and wooden pieces, is beautiful, and provides an elegant piece of furniture in any home.

- Peripherals. ELITE has a built-in clock, while for both there is an optional printer. A Novag chess clock is available for $90. Such an addition may appeal to the serious chess student or those who enjoy speed chess.

- Opening book. The SUPER CONSTELLATION has an opening book of 21,700 moves, about one-fifth of the lines appearing in boldface type in ECO. These lines include some variations 22 moves deep; but in order to meet the special needs of strong players, there is also a built-in option of “customizing” its opening book with up to 1200 additional moves, with variations up to 35 moves long and ordered by priority according to user’s tastes. In contrast, ELITE has a modest opening book which can be supplemented with the cartridge mentioned earlier, each offering between 5,000 and 20,000 additional opening moves.

- Playing Facilities. If hopelessly lost (ELITE with mate impending, SUPER CONSTELLATION in materially hopeless situations as well), both programs are capable of resigning. Both can also recognize and announce all forms of draws, including threefold repetition†, the 50-move rule†, and stalemate. Both also offer a take-back feature for the entire game. Both provide eight preset playing levels ranging from speed chess to infinite. Finally, both programs are capable of displaying the depth of search for a move; this averages 5—6 ply in the middle game at tournament levels, and 10 or more ply in the end game. At infinite levels†, the SUPER CONSTELLATION’s 4-LED binary system can display a search depth of up to 15 ply, while ELITE can go beyond 20 ply.
not give an accurate prediction of its success against humans. Only mor-
er tournament tests can tell us which is stronger; but super con-
stellation’s results have been particularly impressive, leading to its 2018 “Expert” rating.

Two other top-of-the-line products deserve mention, not for their strength of play—which is rather average—but for their other features. Milton Bradley’s Grandmaster (a misnomer) lists at $500, and employs magnets under the board (a technique designed by David Levy) which enable the pieces to appear to move by themselves. Novag’s Robot Adversary (with an 18½” × 18½” unit, 10” board, 2¼” king, listing at $1600!) has a unique mechanical arm which executes all the machine’s moves. It has other standard features, including a modular capability, but offers no great strength of play.

Miniature Products: The Low End of the Line

The first miniature-sized, truly portable, strong chess computer to appear on the market was the Mephisto from Hegener and Glaser, West Germany. At the time of its appearance (1983), there was much excitement about this product due to its size, strength, and humanlike style of play. Despite a departure from the standard brute-force approach (in that emphasis is on more exact evaluation of chess positions rather than deeper search) and although it ran on a much slower microprocessor (68000 at less than 1 MHz), programmers E. Henne and T. Nitsche produced a machine which was, as Irazoqui stated in the Computer Chess Digest 1983, “the second-strongest chess computer available and in many instances as fun to play with as Prestige (then the best Fidelity product).” Its rating was established by Irazoqui at 1820, and in his opinion it was “more active and interesting” than Elit (then Fidelity’s second-best product). Mephisto had a slower clock-speed and shorter depth of search (in the middle game, 4 ply rather than 5 ply with a full-width search†; 8 ply as compared with Elit’s or Prestige’s 10 ply in a selective search†)—which explained why its tactical play was somewhat weaker than that of competitor products. In the end game, Mephisto’s search fell 2–3 ply short of Prestige’s maximum depth of 9–10 ply. This, coupled with the inability to centralize its king when necessary, was responsible for Mephisto’s considerably weaker end-game play (estimated at 1400). In the end game, the king is usually expected to play a more active role, and this is often achieved by bringing him to the center. Nonetheless, in 1983, with an optional auto-response board for $100, Mephisto and its $270 successor, Mephisto II, seemed very appealing and interesting products to buy.

In late 1983, Hegener and Glaser released Mephisto III, which, in the words of Irazoqui, was “positionally more refined . . . tactically faster
and more coherent... a better endgame player” than Hi-
, aztazki continued: “But being much more selective (it looks...ead typically one or two ply full-width and 8 to 20 ply selectively), it has a definite
tendency to overlook a tactical stroke and lose immediately, even after
achieving a winning position...” Hence, Mephisto III was by no means
a definite improvement over Mephisto II, and thus could only be deemed
a major disappointment.

During the past year, there has been an increased interest in miniature
products. The Hong Kong-based company SciSys has produced Travel-
Mate (which lists at $35), the cheapest available chess computer (it can
neither set up or verify positions), and EXPLORER ($70). Another manu-
ufacturer that specializes in portable units is Hanimex (Northbrook, IL).
Its COMPUTACHESS II (with carrying case) and III list at $50 and $80, re-
spectively, and are particularly suitable for the novice.

The miniaturized units tend to use pegboards, operate on batteries, and
have limited playing features. In the past year, Fidelity and Novag have
also started to show a greater interest in the area of products priced under
$100. Novag has introduced the Micro III (listed at $60), which comes
with a pegboard, has seven levels of play, provides a 2-ply take-back, and
runs on batteries or adaptors; Novag also released the PRESTO ($90), which
has modular capability and is particularly suitable for newcomers to the
game. Fidelity has the MINI-SENSORY CHALLENGER ($60), which was one
of the first peg travel sets. It can’t take back, has four levels, and has
optional cartridges for Advanced Play, Great Games, and Book Openings.
The top-of-the-line pegboard unit is Applied Concepts’ PRODIGY ($150)
with a built-in clock, 6-ply take-back facility, and nine levels of play. In
a few years, with further micro-miniaturization, I suspect that top mini-
units will be as strong as today’s CONSTELLATION and DELUXE SUPER 9
(Class A).

The 1984 Chess Life Computer Buying Guide, reproduced as Table 2
in the original of this article in the Summer 1985 issue of ABACUS, gives
complete information on the products discussed here and a few more be-
sides while the best are classified in Table 4 of the same ABACUS issue.
Table 4 is likewise taken from Gertler’s excellent November 1984 Chess
Life article, “So You Want To Buy a Chess Computer.”

Software Products for Personal Computers

Although chess-playing programs for personal computers have existed for
some years, only recently has there seemed to be much interest in their
quality, number, and strength. Hayden Software has suddenly initiated
energetic marketing of SARGON III, another product of the Spracklens,
which has versions compatible with various personal computers and per-
forms at 1815 (U.S.C.F. rating). Additional disk space allows for a massive
opening library, typically ranging up to 15 moves in depth, and with a total of 68,000 positions. Game scores are easily recordable on disk, allowing the standard features of stand-alone machines such as take-back, move suggestions, and various levels of play are available. It is competitive with stand-alone products such as the SUPER 9, and, like most chess computers, it plays well tactically, and not well positionally. Besides its $50 cost, SARGON's most appealing feature is its compatibility with Apple (II, II+ , IIE and IIC, and Macintosh), IBM (PC, PS/1, and Compaq), and Commodore 64 computers.

David Levy and his colleagues at Intelligent Software in London have produced INTELLIGENT CHESS, which runs on the IBM-PC, has excellent interface facilities and color graphics, and plays the openings well. However, its search would have to be deepened for it to attain a reasonable quality of middle-game play.

Other computer chess researchers, notably Larry Atkin and David Slate of the long-dominant Northwestern University program, and Bruce Wright of Duke University's former leader DUCHESS, have recently turned to producing software for PCs. Atkin and Slate produced Odesta's CHESS 7.0, which is a takeoff from their MORPHY, STEINITZ, and other GREAT GAME MACHINE modules. It plays about 1700-level chess, and is compatible with the Apple II or IIE and the IBM-PC. Wright has released CHESSWRIGHT, which has many nice features, including accepting and responding to input in either algebraic or descriptive notation, seven levels of play, and the ability to save and restore games on disk. It also has an extensive opening book; it can be used to set up problems, and has a digital chess clock among many other facilities, although its strength in terms of rating is still undetermined.

In short, the software products for personal computers offer many nifty user interface and set-up facilities. For under $50, it is possible to purchase disks with additional opening libraries and stored games. The fact that personal-computer programs are not yet quite up to the standards of stand-alone chess computers is primarily due to the higher performance of the 6502 microprocessor (commonly used in the stand-alone chess computers),

The photos that follow provide just a hint of the diversity of different chess computers. Among the products offered by Fidelity International are: the top-line ELITE A/S, of which a preliminary version won the 1983 World Microcomputer Chess Championship in Budapest (A); the ELEGANCE, a prototype of which won the Canadian Computer Chess Invitational Championship 1984 (B); and the new EXCELLENCE, which was designed as an outstanding modestly-priced model (D). The AMBASSADOR was a midrange unit marketed by Conchess (C); the SciSys CHESS CHAMPION Mark V is an inexpensive portable unit (E). The SUPER CONSTELLATION, Novag's strongest product, was the first Expert-rated microcomputer (F). [Pictures A, B, E, and F courtesy of the U.S. Chess Federation.]
compared to the 68000 and 8088 microprocessors used in the Apple and IBM personal computers, respectively.

Future Prospects

Professor Donald Michie has some very interesting things to say about future prospects in an interview conducted by H.J. van den Herik, "Computer Chess Today and Tomorrow," which appears in the Computer Chess

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**CONSTITUTION-X versus Jerry Simon**

The following game is historic because it is the first in which a microcomputer chess program beat a rated master under tournament conditions. (Notes are based on Scott McDonald's comments in the Computer Chess Digest 1984, page 25.)

**White:** CONSTITUTION-X. **Black:** Jerry Simon (2207). English Opening.

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<td>15</td>
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<td>h3</td>
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<td>18</td>
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<tr>
<td>19</td>
<td>d4 (f)</td>
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<tr>
<td>21</td>
<td>f3!</td>
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<tr>
<td>23</td>
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<td>24</td>
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<td>25</td>
<td>fxe</td>
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<td>Rce1</td>
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<td>27</td>
<td>Rf2</td>
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<tr>
<td>28</td>
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<tr>
<td>30</td>
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<tr>
<td>33</td>
<td>Be3! (k)</td>
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<td>34</td>
<td>Ke2</td>
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<tr>
<td>35</td>
<td>Kd3</td>
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<td>37</td>
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<td>54</td>
<td>Qe3+</td>
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<tr>
<td>55</td>
<td>Qe1</td>
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</table>
(a) A solid but passive move which took the computer out of its book. Usual moves are 4 ... Bb4 and 4 ... d5.

(b) Constellation prevents black's planned bishop trade with 8 ... Bh3.

(c) A useful centralization. If black plays Bxd5, white has play on the half-open c-file after cxd5. With this and its next move, Constellation-X demonstrates some understanding of pawn structure play.

(d) More sound was 15 ... f5 here.

(e) Better was 18 ... Bf6.

(f) Constellation-X completes its planned break, although with 19 ... ed 20 ed Re4 black would have some play.

(g) The N must be retained, when black will soon suffer from his weaknesses on the dark squares.

(h) Black tries to press the attack.

(i) Better was 26 ... Rh6.

(j) Black has played an intuitive piece sacrifice based upon the exposed position of the WK; but now, since deep and precise calculation are the order of the day, Constellation-X must be winning.

(k) The only move (since 33 Qxg3 Qxg3 34 cxb7 allows Qf3+ where black wins), and now the WK escapes.

(l) White now has an easily won game.

Digest 1984. Although Michie discusses computer chess in general, a number of his points are relevant to the future role of commercial chess computers in particular. His basic position is that computers will continue to pervade every facet of chess as long as Grandmasters and the professionals who make a living from the game allow them to do so. Indeed, I doubt that the chess elite could do anything to alter this trend, even if that were their intention. Human chess has already benefitted a great deal from computer chess in terms of analysis, opening and end-game theory, and understanding. Chess computers can already serve as excellent learning tools for the human novice or intermediate player.

By 1990, Michie foresees that we may well have a World Chess Champion of machine origin, and if we don't, then cooperation with computers could bring the level of World Championship caliber chess by humans over the 3000 rating mark! Hence, Michie perceives that computer chess may best serve as a "support-vehicle" for human chess masters, and therein lies the principal challenge to computer science and artificial intelligence. In my opinion, this forecast is a bit optimistic. Even if we do have a World Chess Champion of machine origin in 1990, I very much doubt that it will be through artificial intelligence techniques such as an attempt to decode the chess knowledge in a Grandmaster's head! Research trends and developments during the past ten years do not support Michie's forecast.

Michie suggests that there may even be a new class of tournament comprised solely of human/machine combinations, which he calls "man-ma-
machine consultation chess.” In the event that machines become too strong for humans, there would be restrictions or rations on the amount of resources (such as CPU time) allotted to each competitor, much as in the case of car or motorcycle racing. The point is that there would still be interest in human competitive chess, and interest in computer chess would turn from considerations of strength of play to the evaluation of programs as possible learning tools for humans.

Postscript

A final note about the outcome of FIDELITY-X versus NOVAG-X (page 248): While this article was in production, Kittinger reported to me that the SUPER CONSTELLATION now finds 30 Qg5 after 6 minutes of think time. It had apparently searched one ply short of being able to find the mating sequence.

Acknowledgments

The author wishes to thank Dan and Kathe Spracklen, Dave Kittinger, Mr. Jean Leduc of CERVO-2000, and Enrique Irazoqui for providing useful information. The U.S. Chess Federation welcomes any enquiries regarding commercial chess computers; their address is 186 Route 9W, New Windsor, NY 12550.

References