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

RATING	CLASS	

HUMAN CONTESTANTS:

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

2800

2700

2600 — World Class Grandmaster

2500 — Grandmaster

2400 — International Master or U. S. Senior Master — Danny Kopec, (ABACUS author) (2410)*

Master

2200 —

Expert

OUTSTANDING CHESS PROGRAMS:

BELLE (2195)
CRAY BLITZ (2148)

COMMERCIAL CHESS COMPUTERS:

SUPER CONSTELLATION (Novag) (2018)

2000 —

Class A

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

1800 —

Class B

Middle-line Fidelity, Novag, SciSys products
MEPHISTO

1600 —

GREAT GAME SYSTEM (Applied Concepts)

Class C

1400 —

Low end of the market (miniature products)

Class D

1200 —

Class E

Early products like CHESS CHALLENGER 10

1000 —

*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 1, 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 ? ~arance on the commercial microcomputer market in the fall of 1984, re   ..ly became the first microcomputer program rated "Expert" (2018). 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 fo. ng 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	Nb1	

—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-
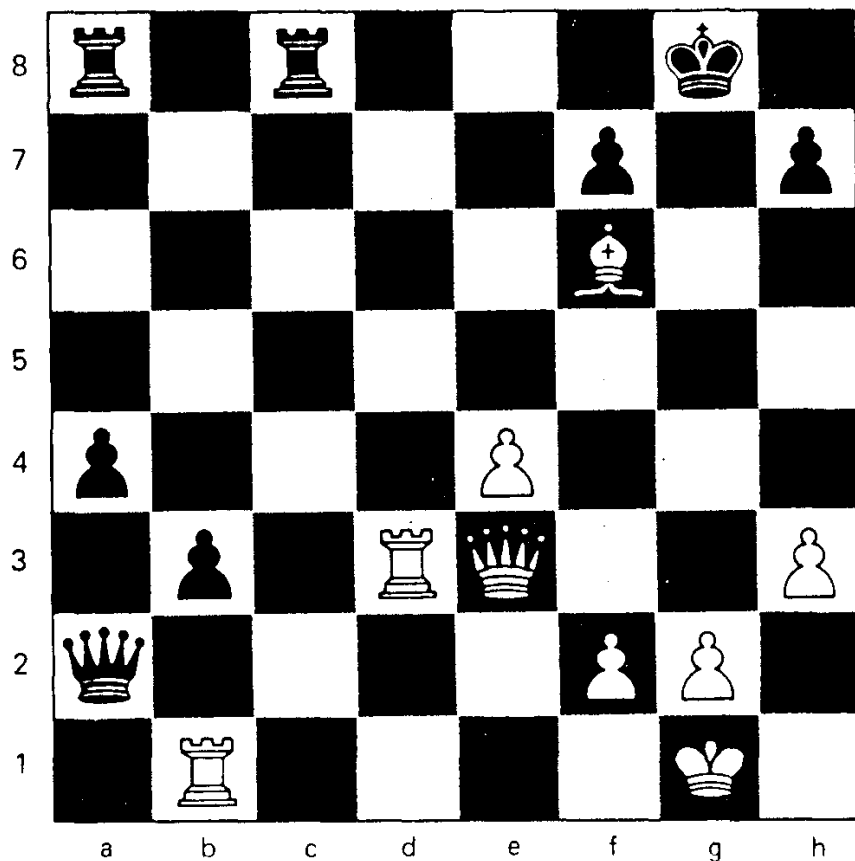
Position after 29. . . Qa2

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** . . . . gxf6, **31 Qh6** wins.

31	Qg5	Qf8
32	Qh6	

To be continued

Fancy, but not effective. Better and mo' ʼnsistent was **32 Rg3 g6 33 Bd₄** .en **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	....	Rxf8
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 tournment, 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 ... Rxg2** 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, PRINCHESS-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" × 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 cartidges 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 takeback 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†, theSUPER 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 ser' tournament tests can tell us which is stronger; but SUPER CON STE..._.TION'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 AD-VERSARY (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 ELITE (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 ELITE'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 ME-PHISTO'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 ` `HISTO II. Irazoqui continued: "But being much more selective (it look. .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 manufacturer that specializes in portable units is Hanimex (Northbrook, IL). Its COMPUTACHESS II (with carrying case) and III list at $50 and $80, respectively, 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 besides 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 performs 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 tot:' ᶠ 68,000 positions. Game scores are easily recordable on disk, ar mo. ᵢ 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, PC-XT, 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),

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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.]
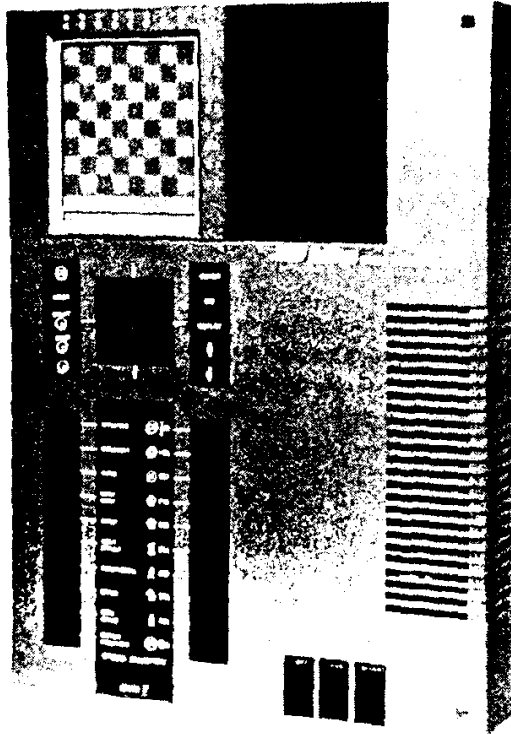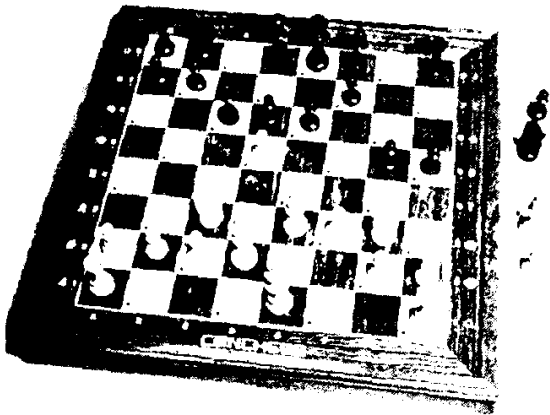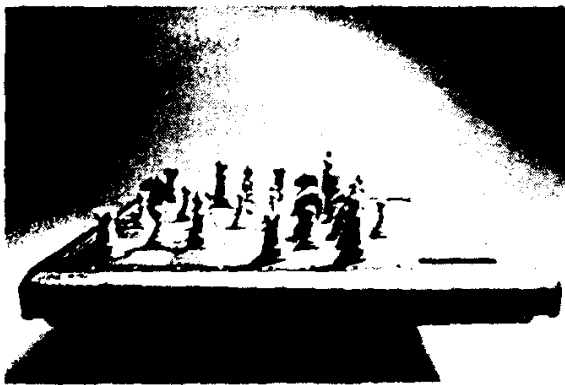
A

D

B

C

E
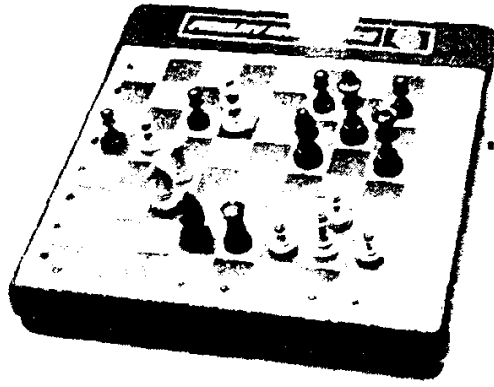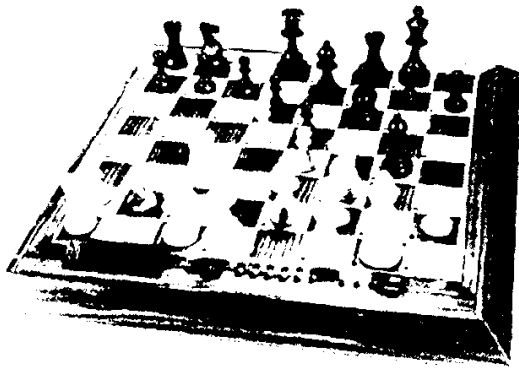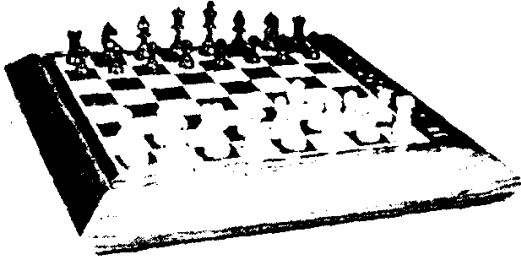
F

compared to the 68000 and 8088 microprocessors used in the Apple and IB ersonal 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*

CONSTELLATION-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.)

U.S. Open, August 1983, Round 1.
White: CONSTELLATION-X. **Black:** Jerry Simon (2207). English Opening.

	W	B		W	B
1	c4	e5	29	Re8 +	Kg7
2	Nc3	Nc6	30	d5 +	Kh6
3	Nf3	Nf6	31	dxc6	Qh2 +
4	g3	d6 (a)	32	Kf1	Rxg3
5	Bg2	Be6	33	Be3! (k)	Qh1 +
6	d3	Be7	34	Ke2	Qh5 +
7	0–0	Qc8	35	Kd3	bc
8	Qb3 (b)	0–0	36	Qf6 +	Qg6
9	Nd5! (c)	Bd8	37	Qh4 +	Kg7
10	Bg5	Rb8	38	Qd8	Kh6
11	Nxf6 +	gxf6	39	Qxc7 (*l*)	d5
12	Bh6	Re8	40	Qxa7	dxc4 +
13	Qc3	Bh3	41	Kxc4	Rg2
14	Rac1	Bxg2	42	Qd4	Rc2 +
15	Kxg2	Qg4 ?! (d)	43	Kb3	c5
16	Bd2	f5	44	Qd5	Rh2
17	h3	Qh5	45	Qxc5	Rh3
18	e3	Re6 (e)	46	Kc2	Rh2 +
19	d4 (f)	e4?	47	Bd2	Qg2
20	Ng1	Rg6	48	Qf8 +	Kh5
21	f3!	Bh4	49	Qxf7 +	Kh4
22	Ne2	Bg5	50	Qe7 +	Kh5
23	Nf4! (g)	Bxf4	51	Qxh7 +	Kg4
24	exf4	Re8	52	Qg7 +	Kf3
25	fe	Rxe4 (h)	53	Qc3 +	Kf2
26	Rce1	Re2 + (i)	54	Qe3 +	Kf1
27	Rf2	Rxf2 +	55	Qe1	Mate
28	Kxf2	Qxh3 (j)			

Notes

(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 r   ed, when black will soon s. .r 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 Qxq3 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-

cnine consultation chess.'' In the event that machines become too strong for h   ns, there would be restrictions or rations on the amount of re-sourcᴄᴜ (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

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