

MATHEMATICAL GAMES

Checkers, a game that can be more interesting than one might think

by Martin Gardner

"The game of draughts we know is peculiarly calculated to fix the attention without straining it. There is a composure and gravity in draughts which insensibly tranquillises the mind."

—JAMES BOSWELL,
The Life of Samuel Johnson

The quotation is from a section for the year 1756 in which Boswell writes about Johnson's preface to William Payne's *Introduction to the Game of Draughts*, published the same year in London. That book, by a mathematics teacher, was the first in English on the game that in the U.S. is known as checkers. Johnson seldom played the game after leaving college. Boswell expresses regret over it because he thinks checkers playing would have afforded his friend "innocent soothing relief" from periodic bouts of depression.

Nothing is known about the beginnings of checkers, although most game historians now think it originated in southern France sometime in the 12th century. In Britain and the U.S. it is surely the best-known of all board games when you consider the number of children who learn to play it and never forget its rules, even though checkers is far below chess in the size of its literature, in the number of adults who be-

come top-level players and in the public excitement generated by contests for the world checkers championship. How many people can name a single checkers expert or tell you who the current world champion is? He is Dr. Marion F. Tinsley, a topologist in the department of mathematics at Florida A. and M. University and probably the greatest checkers player who ever lived.

Rules for chess are now standard throughout the Western world, but not so for checkers. Outside of English-speaking countries there are dozens of regional variations. The version most popular in Europe and the U.S.S.R., called Polish checkers (except in Poland, where it is called French checkers), is played on a 10-by-10 board, each side starting with 20 men. It is the standard French form of the game. In French Canada the board is even larger: 12-by-12, with 30 pieces to a side. Rules for checkers differ widely around the world. It is curious to note that in all European countries except Britain the pieces are called ladies; only here and in English-speaking countries are they men.

Several consequences follow from the fact that checkers is simpler than chess. One is that a grand-master checkers player is less likely than his chess counterpart to lose to an inferior by making an error. For checkers buffs this is one of the game's great attractions. They love to quote Edgar Allan Poe's discussion of the two games at the beginning of *The Murders in the Rue Morgue*:

"I will, therefore, take occasion to assert that the higher powers of the reflective intellect are more decidedly and more usefully tasked by the unostentatious game of draughts than by all the elaborate frivolity of chess. In this latter, where the pieces have different and *bizarre* motions, with various and variable values, what is only complex is mistaken (a not unusual error) for what is profound. The *attention* is here called powerfully into play. If it flag for an instant, an oversight is committed, resulting in injury or defeat. The possible moves being not only manifold but involute, the

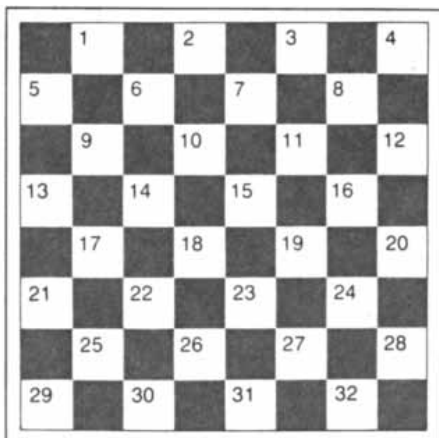
chances of such oversights are multiplied; and in nine cases out of ten it is the more concentrative rather than the more acute player who conquers. In draughts, on the contrary, where the moves are *unique* and have but little variation, the probabilities of inadvertence are diminished, and the mere attention being left comparatively unemployed, what advantages are obtained by either party are obtained by superior *acumen*."

Tinsley has put it this way: "Playing chess is like looking out over a limitless ocean; playing checkers is like looking into a bottomless well."

Another consequence of the simplicity of checkers is that by 1900 the game's openings had been so completely analyzed that most tournaments ended in draws. To inject more drama into the play Britain introduced (in about 1900) the practice of putting on cards every pair combination of Black's first move and White's response. Before each match a card was chosen at random, and the game had to be played with the specified pair of opening moves. Since each side has a choice of seven moves, there are 49 possible pairs. Two of them (9-14, 21-17, and 10-14, 21-17) were ruled out because they give away a white piece. Later it was found that two more pairs (11-16, 23-19, and 12-16, 23-19) give Black such a strong advantage that they too were discarded, leaving 45 cards.

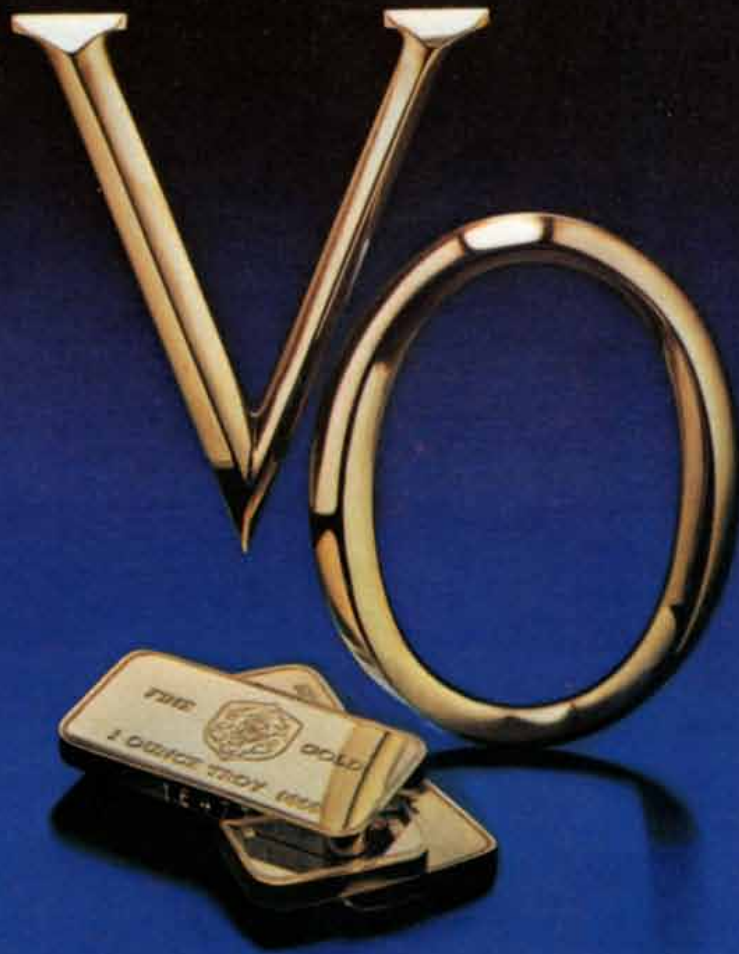
Standard checkers notation is based on the numbering of squares shown in the illustration on this page. For reasons of clarity it is customary in checkers diagrams to reverse the colors of squares and show the pieces on white cells instead of black. Actual play is always on black squares, with the "double corner" at each player's lower right. The players are customarily called Black and White even though the pieces are red and white. Tournament games are now played on green-and-buff boards; black-and-red boards are considered toy-store atrocities. Black always moves first, and games are recorded with Black starting on the low-numbered cells. If you work on any of the recreations in this column, it is a good idea to label the black squares of your board as shown.

Alas, as decades went by experts soon became so familiar with all variations that follow the two-move openings that "safe" play was adopted and the draws began to pile up again. The British "two-move restriction" was replaced in the U.S. in the mid-1930's by the "three-move restriction," a practice now followed in most checkers tournaments here and in Britain. There are 142 cards, each with a different triplet of the first three moves. Because many of these triplets give an advantage to one side (usually the second player) two games are played with each selection to allow each player the first move.



Squares are numbered for checkers notation

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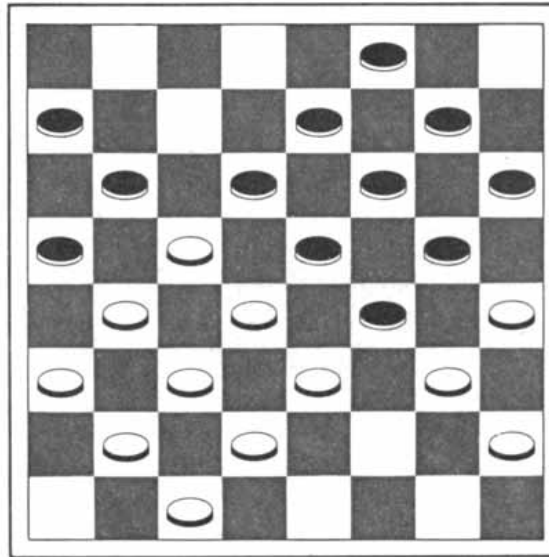
Fiesta 3-Door Sport

Without the opening-moves restrictions, a practice known as go-as-you-please play, experts would play nothing but draws. Even with the three-move restriction about 80 percent of all tournament games still end in draws. When an expert does win, it is usually because the loser made a blunder or because the winner managed to keep secret (sometimes for years) a "cook" he had discovered. As in chess, a cook is an improvement on standard "book play" that catches an opponent by surprise. Players have traditionally been allowed only five minutes to think before each move and one minute for a capture that can be made only one way. In recent years this practice has been replaced by the use of chess clocks, and players are allowed 30 moves in an hour. When someone springs a new cook, his victim simply does not have enough time to analyze it.

In 1967 the late Walter Hellman, a steelworker in Gary, Ind., who was then world champion, defended his title against the U.S. champion, Eugene Frazier. The contest went to 36 games, of which 31 were draws and five were wins by Hellman. Hellman's last win was on a cook. "I had used that cook once before," Hellman told a reporter, "but it had never been published. Frazier had one possible move to thwart the attack, and five minutes doesn't allow much time to figure it out."

A third consequence of the simplicity of checkers is that the best computer programs for checkers play a more formidable game against middle-level players than the best computer programs for chess. Until a few years ago the strongest checkers program was the work of Arthur L. Samuel, a learning program that improves as it plays. Since retiring as IBM's director of research, Samuel has continued to improve his program at Stanford University's Artificial Intelligence Laboratory. In recent years a powerful program of the non-learning type has been developed by Eric C. Jensen and Tom R. Truscott, two graduate students at Duke University working under Alan W. Biermann, who teaches artificial intelligence. It is thought to be stronger than Samuel's program, although this has not yet been determined by a definitive match.

Checkers players are ranked on three levels: minor, major and master. Backers of the Duke program believe it plays initially on a master level. After playing against the program for a while, however, a grand master can discern its weaknesses and begin to exploit them. Its greatest weakness is that it plays without master plans. It does not even follow book moves in opening play, usually scattering its pieces over the board in patterns grand masters consider stupid. Its strength is the incredible speed with which it can analyze all possible moves to much greater depths than



The shortest no-capture checkers game

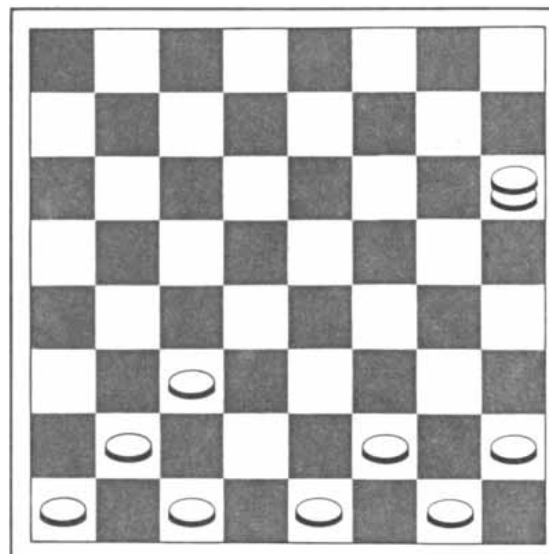
BLACK	WHITE
1. 9-13	24-20
2. 12-16	21-17
3. 10-15	23-18
4. 15-19	18-14
5. 8-12	25-21
6. 4-8	29-25
7. 6-10	27-23
8. 10-15	23-18
9. 2-6	31-27
10. 6-9	27-24
11. 1-6	32-27
12. 6-10	27-23

a human opponent, and within those depths it never makes a mistake. Chess programs may still be decades away from grand-master play, but the Duke program, Biermann believes, is already "knocking at the door" of the world championship. Jensen and Truscott regard it as now being about the 10th strongest player in the world.

Grand-master checkers players, like their chess counterparts, take a much dimmer view of the quality of computer programs. They all agree with W. Burke Grandjean, secretary of the American Checker Federation, who considers the optimism of the Duke group to be ludicrously naive. Backed by the federation, Tinsley has a standing bet of \$5,000 that in a stake match of 20 games he can beat any computer program devised over the next five years. Biermann thinks Tinsley would now defeat the Duke program, but not without losing a few games. Grandjean says he can easily find 20

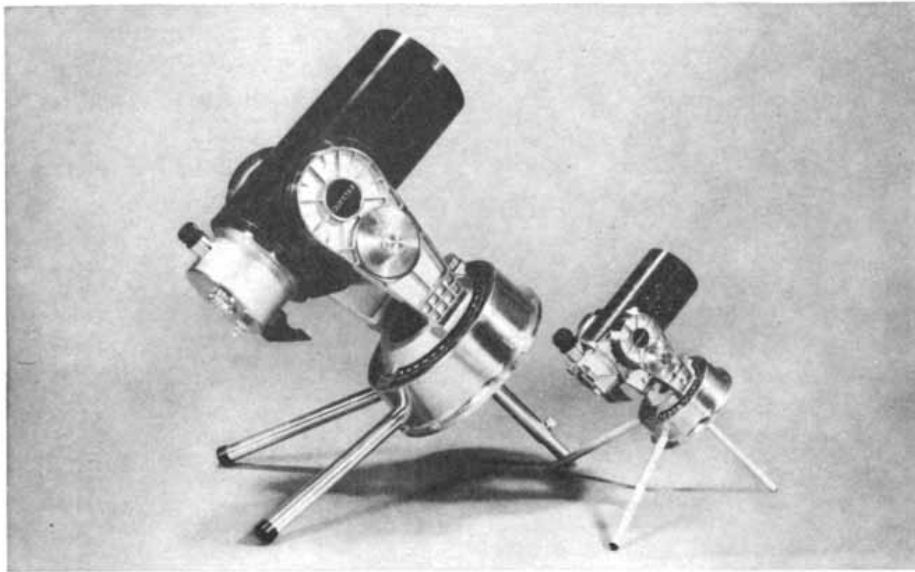
players who would make side bets of \$100 each that Tinsley would not lose a game, and he personally believes Tinsley would win all 20. Perhaps we shall soon find out. (Readers interested in joining the American Checker Federation and receiving its monthly *Bulletin* can write to Grandjean at 3475 Belmont Avenue, Baton Rouge, La. 70808.) Fidelity Electronics now has on the market Checker Challenger 2, an inexpensive solid-state machine that plays on two levels, and also Checker Challenger 4, which plays on five levels, although its top level is considered below the levels of the Samuel and Duke programs.

In chess it is easy to prove that the "fool's mate," in which the second player checkmates on his second move, is the shortest possible chess game. Surprisingly, the shortest checkers game is not yet known. Until two years ago it was thought to be the 24-move blocked game shown in the illustration above, in



The shortest checkers game known

BLACK	WHITE
1. 11-16	21-17
2. 10-14	17x10
3. 6x15	23-18
4. 2-6	18x2 (K)
5. 9-14	2x18
6. 3-7	24-20
7. 1-6	20x2 (K)
8. 12-16	2x9
9. 5x23	26x3 (K)
10. 4-8	3x12



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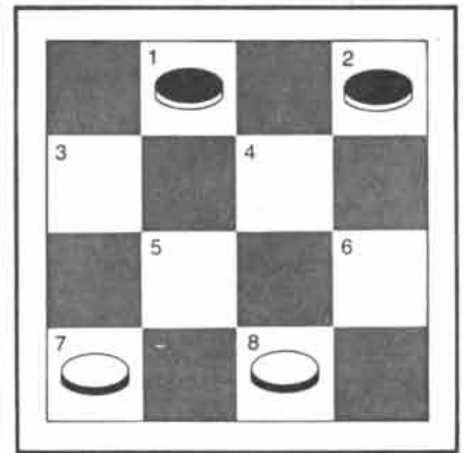
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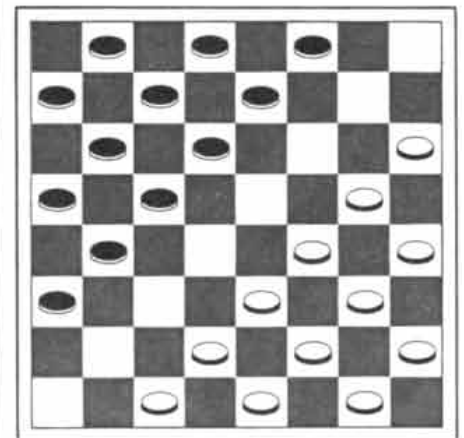
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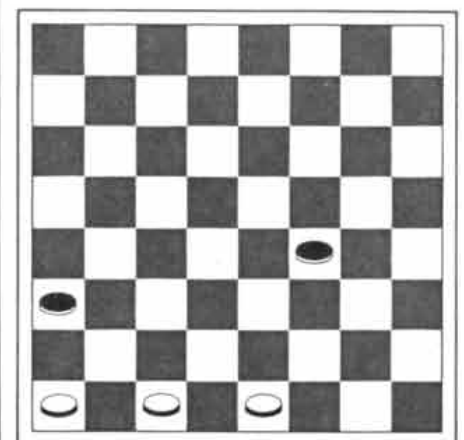


A minicheckers puzzle

which the board displays the final position. There are many sequences of 24 moves that lead to this position, but the position itself is thought to be unique. In the line of play given every White move is symmetrically opposite (with respect to the board's center) to Black's preceding move. I do not know who first put the play in this symmetrical form. The version I give, worked out by Rudolf Ondrejka of Linwood, N.J., begins with the



Diagonal checkers



A hustler's checkers bet

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two-move Edinburgh opening. Because 9-13, a favorite first move among tyros, is considered the worst possible start for Black, the symmetrical game is more often started with 10-15, 23-18, an opening known as the Kelso Cross.

Sam Loyd, in his *Cyclopedia of Puzzles* (1914), page 379, using an eccentric notation that incorrectly assumes the board has been rotated 90 degrees, records a nonsymmetrical sequence of moves ending with the same pattern. Loyd states flatly that it is the "shortest possible game." The 24-move blocked game is indeed (as can be proved) the shortest game in which there are no captures. In 1978, however, Alan Malcolm Beckerson, problems editor of *English Draughts Journal*, discovered that White could win on his 10th move (20 moves in all) by capturing all Black's pieces! This is now the shortest checkers game known, although no one has yet proved that no game can be shorter. Beckerson found other 20-movers that capture all the black pieces, as well as some 20-movers that end in blocked games after some captures. The version given in the bottom illustration on page 25, with the board showing the final position, was first published in the British monthly *Games and Puzzles* for March, 1978. Its two-move opening is known as the Newcastle.

Many other minimum-move checkers tasks are far from settled. In how few legal moves can a game produce 24 kings? The best-known solution, in 90 moves, appeared in *Journal of Recreational Mathematics* (Vol. 9, No. 1, page 45; 1976). In how few moves can Black and White reverse their initial positions? It takes at least 60 moves for either side, alone on the board, to occupy the opposite starting cells, and so it follows that 2×60 , or 120, is an absolute lower bound. A solution in 172 moves is given in a late-19th-century English book, *The Draughts-Player's Guide and Companion*, by Frank Dunne, pages 94-95. At the finish each side has six kings. It seems likely that 172 moves can be considerably lowered.

It is interesting to try this problem on smaller boards. The 3-by-3 is trivial, but the 4-by-4 presents a pleasant puzzle. Starting as is shown in the top illustration on the opposite page, the task is to interchange the two sides in a minimum number of legal moves. Captures are of course compulsory. At the finish all four pieces will necessarily be kings. I shall give a solution next month. Incidentally, five moves are needed for the shortest game on this miniboard. If both sides play to win and follow their best strategy, the game is a draw.

As with chess, endless ways of playing checkers have been proposed by varying the shape of the board, the starting position, the rules and so on. A privately published French book, *Les jeux de*

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dames non orthodoxes et autres jeux à pions, by Joseph Boyer and Vern R. Parton, gives more than 100 such variants. Some are played on triangular or hexagonal tessellations and some on three-dimensional boards; some mix chess pieces with checkers and some allow three or four players to compete at once. As one would imagine, it is hard to draw a line between a game similar enough to checkers to be called a variant and one so different from checkers that it is best regarded as another game altogether. The so-called Turkish checkers, for example, has almost no resemblance to checkers except that it is played on an 8-by-8 board with counters of two colors. One simple way to vary standard checkers is to start with the men positioned as is shown in the middle illustration on page 26. All checkers rules hold. The opening moves quickly lead to patterns not encountered in orthodox games.

The most eccentric variation of checkers, about which one would like to know more, is "supercheckers," invented by Charles Fort, the Bronx collector of science anomalies who had a marked influence on science fiction as well as on the current epidemic of interest in the paranormal. According to Fort's biographer Damon Knight (*Charles Fort*, Doubleday, 1970), supercheckers was played "with armies of men on a board with thousands of squares. Fort used bits of cardboard with carpet-tack handles for the men, and a piece of checkered cloth for the board."

The two players start with their forces in any agreed-on formation that has a space between the two armies. If a player moved only one man at a time a game might last for weeks, and so Fort allowed for movements en masse. Here is how he put it in a letter: "Let *A* start out, moving until *B* tells him to stop—say a hundred moves. Then *B* makes a hundred moves. *A* may want to make another hundred moves, but *B*, sizing up the situation, tells him to stop, say at thirty. Then perhaps occurs 'fighting,' at close quarters, one move at a time, as in ordinary checkers. But, at any time, if either player wants to make a 'mass movement,' that is a matter of obtaining permission from his opponent."

A game usually lasted all night. In 1930 Fort wrote to Tiffany Thayer, who edited the first Fortean magazine, *Doubt*: "Supercheckers is going to be a great success. I have met four more people who consider it preposterous."

In Britain and the U.S. the most popular variant of checkers is "giveaway." It differs from the standard game only in that the object is to be the first to lose all one's men. In Dunne's book cited above, pages 91-92, there is a fantastic giveaway "sucker bet," presumably devised by British checkers hustlers. White begins with his 12 men in the usual starting

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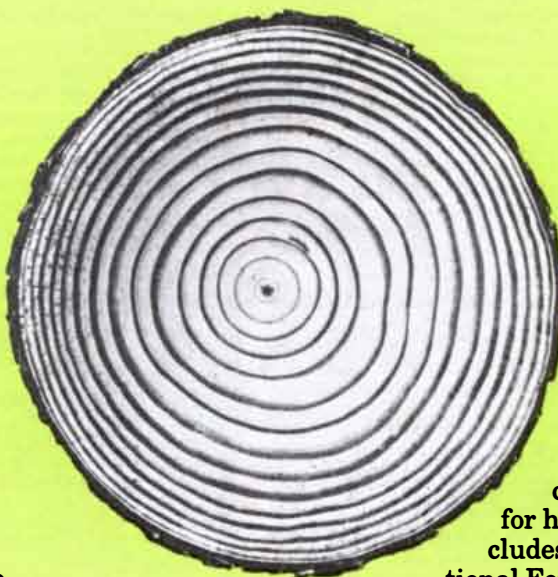
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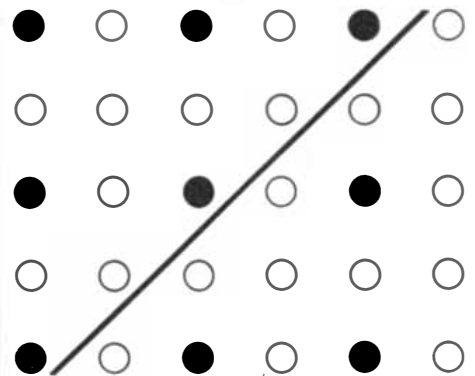
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An Aha! solution

position. Black has only a king on cell 7. Black wins if he loses his king. White wins if he loses all 12 men. Dunne shows how White can always win and gives three similar wagers in which Black begins with a single uncrowned piece on cell 1, cell 4 or cell 5.

Among hundreds of hustler wagers, one of the best begins with the position shown in the bottom illustration on page 26. (I am indebted to Mel Stover for passing it along.) It is Black's turn. White wagers that Black will not be able to crown the piece he moves first. Clearly Black should not move the piece on cell 21 because he would lose it immediately, so that the question is whether Black can move the piece on cell 19 and advance it to his king's row. The more you study the pattern, the more obvious it seems that Black can win the bet easily. Nevertheless, White wins. It is an amusing bet to make with friends. If you cannot fathom White's strategy (and there are no joke catches), you will find the answer here next month.

One final problem. It is widely believed two kings can always win against one king, but that is not invariably true. See if you can place two white kings and one black king on the board in such a way that even though it is White's turn, Black can force a draw.

The first of last month's short problems was answered at the end of that column. The solutions to the remaining problems are as follows:

2. The poker puzzle is answered when we consider the fact that a hand with four identical values always has a fifth card. For each four of a kind there are 48 different fifth cards. Consequently there are 48×13 , or 624, different poker hands containing four of a kind, compared with 40 hands that are straight flushes. It is therefore much less likely that you will be dealt a straight flush, and for this reason a straight flush beats four of a kind. The problem was contributed by M. H. Greenblatt to *Journal of Recreational Mathematics* (Vol. 5, No. 1, page 39; January, 1972).

3. Here is how Raymond Smullyan, in

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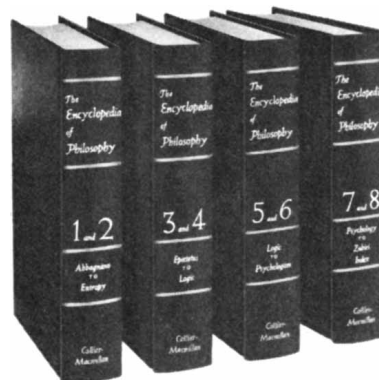
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his new book *The Chess Mysteries of Sherlock Holmes* (Knopf, 1979), proves that, given the chess position shown last month, Green made the first move.

"Red is now in check, hence Green moved last. It remains to determine who moved first, which can be done by figuring whether an odd or an even number of moves have been made.

"The rook on *b1* has made an odd number of moves; the other three rooks have each made an even number of moves (possibly zero). The Red knights have collectively made an odd number of moves, since they are on squares of the same color, and the Green knights have collectively made an even number of moves. [A knight changes square color on each move.] One king has made an even number of moves (possibly zero), and the other king an odd number. The bishops and pawns have never moved, and both queens were captured before they ever moved. So the grand totality is odd. Thus Green moved first. Hence Green is White and Red is Black."

4. Surprising as it may first seem, both the richest and the poorest classes in Oilaria would prefer pair averaging from the top down. Those in the richest class would prefer to be averaged with the next-richest class before the latter is reduced in wealth by averaging. Those in

the poorest class would prefer being averaged with the next-poorest class after the latter has been increased in wealth by averaging.

An example will make this clear. Assume that the wealth of the five classes is in the proportions 1:3:4:7:13. Averaging from the bottom up changes the proportions to 2:3:5:9:9. Averaging from the top down changes the proportions to 3:3:5:7:10.

5. Divide the 500-mile track into 10 segments of 50 miles each. If any segment is traversed in one hour, the problem is solved, and so it must be assumed that traversing each segment takes either less than an hour or more than an hour. It then follows that somewhere along the track there will be at least one pair of adjacent segments, one (call it *A*) traversed in less than an hour and the other (call it *B*) traversed in more than an hour.

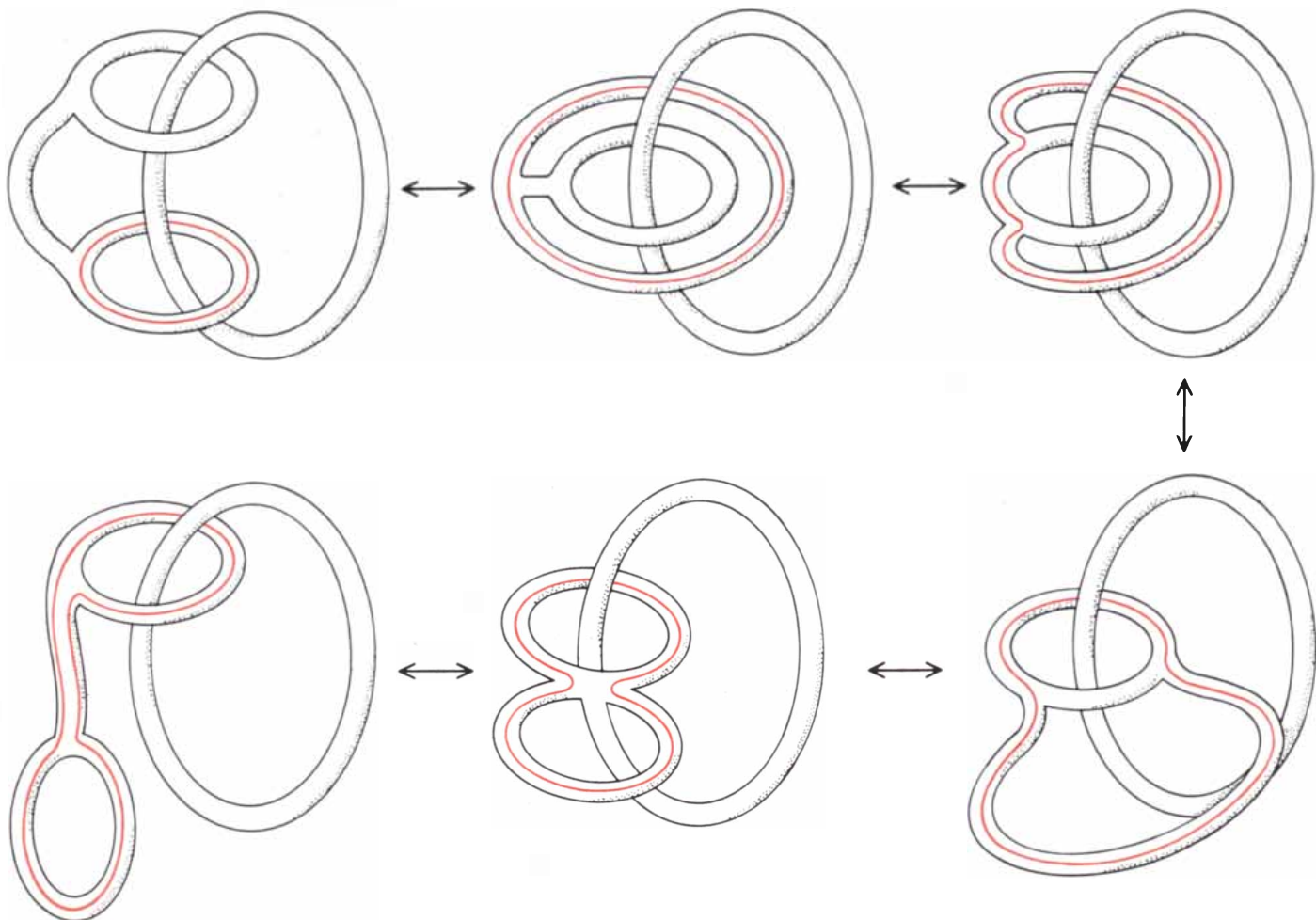
Imagine an enormous measuring rod 50 miles long that is placed over segment *A*. In your mind slide the rod slowly in the direction of segment *B* until it coincides with *B*. As you slide the rod the average time taken by the train to go the 50 miles covered by the rod varies continuously from less than an hour (for *A*) to more than an hour (for *B*). Therefore there must be at least one position

where the rod covers a 50-mile length of track that was traversed by the train in exactly one hour.

6. The Aha! insight that solves the counter-jumping puzzle is to color nine spots as is shown in the illustration on page 30. It is obvious that, no matter how jumps are made, a penny on any colored spot can go only to another colored spot.

There are six colored spots above the line and only three below it. Therefore, by the pigeonhole principle, there must be three pennies above the line that have nowhere to go below the line. The task of moving all the pennies to spots below the line cannot be accomplished unless at least three pennies, on three colored spots, are removed from the top triangular array. Remove any three such pennies and the transfer of the remaining 12 is a simple task.

7. The illustration below shows how a continuous deformation of the two-hole torus will unlink one of its holes from the single-hole torus. The argument given last month for the impossibility of this task fails because if a ring is painted around one hole (as is shown by the colored line), the ring becomes distorted in such a way that after the hole is unlinked the painted ring remains linked through the one-hole torus.



Solution to the linked-tori problem