MATHEMATICAL GAMES

The game chosen for this issue of Parabola is played by two people on a 10 x 10 chessboard. The squares of the board are numbered from 1 to 50 starting from two opposite sides of the board (see figure). Each person has a set of 10 playing pieces which are numbered from 1 to 10 (10 draughtsmen with numbers will do) and the two sets are of different colours (e.g. black and white).

41	42	43	44	45	46	47	48	49	50
31	32	33	34	35	36	37	38	39	40
21	22	23	24	25	26	27	28	29	30
11	12	13	14	15	16	17	18	19	20
1	2	3	4	5	6	7	8	9	10

To set the board up ready for play, the pieces are placed on their respective numerals on the opposing sides of the board. The players then, in turn make "moves" according to the following two rules: (i) The piece that is to move, must be moved onto a multiple of its value in the next row forward (the number can be facing either way). (ii) No two pieces from the same set can occupy the same square. For example a first move could be to move the 5-piece from 5 to 15 or 20. A later move could be to move on to 25 or 30 (but 30 is impossible if your 2-piece or 3-piece is already there).

As the game progresses you will find opportunities will arise to capture your opponent's pieces. This is done by moving your piece onto a square which your opponent occupies and removing his piece. The game concludes when all playing pieces of your set have passed all of your opponent's pieces. The values of the remaining pieces of your set are summed to give you a score. The player with the higher score wins the game.

It is quite obvious that the pieces with the higher numerals on them would be worth some sort of protection as they will add more to your score. You will also see that the pieces with the low numerals are very powerful capturing pieces. The 1-piece for instance can move to any square in the next row on any move, and can consequently capture any of your opponent's pieces; while at the same time (by sitting on prime numbers) can remain immune from attack from all your opponent's pieces except of course his 1-piece.

After you have played the game for a while, you might write and let us know of any attacking or defensive patterns of play you have discovered.

K. Wilkins

PENTOMINOES (Some Remarks)

Recall that the rules of this game were set out in the previous issue of Parabola. The apparatus needed is a chess board together with cardboard cutout pentominoes, one of each of the twelve possible types. The two players alternately place a pentomino on the board not overlapping any pentomino already on the board and the last player to move wins.

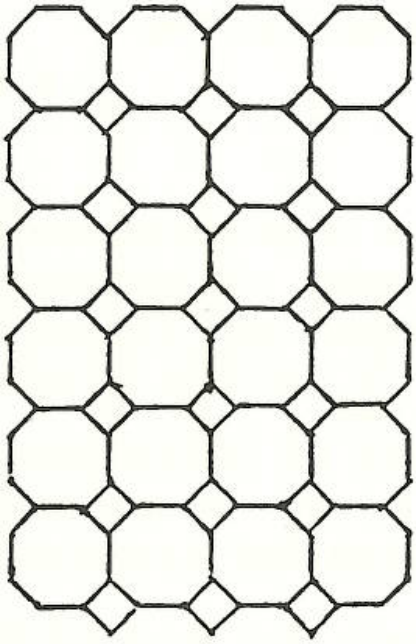
This game is undoubtedly simpler than chess and probably simpler than draughts. It is still not trivial to analyse, and in practice the more experienced player will tend to win. The following comments are based on a small number of trial games by some of our staff members.

In practice, the game will take 7, 8 or 9 moves. Thus the second player is interested in forcing an 8-move game. Let us call the first two moves the 'opening', the next two the 'middle game' (for raw beginners, the next three or four are the 'middle game') and the rest the 'end game'. It appears to need more experience and experiment to say anything useful about the opening – so until you have such experience just play anything. In the middle game, one may be trying to use up the more manoeuvrable pentominoes and to place them to waste space (e.g. by leaving isolated patches of 4 unused squares) or one may be trying to use up the less manoeuvrable pentominoes and to place them to conserve space. It is necessary to think how long a game you are aiming at. In practice the

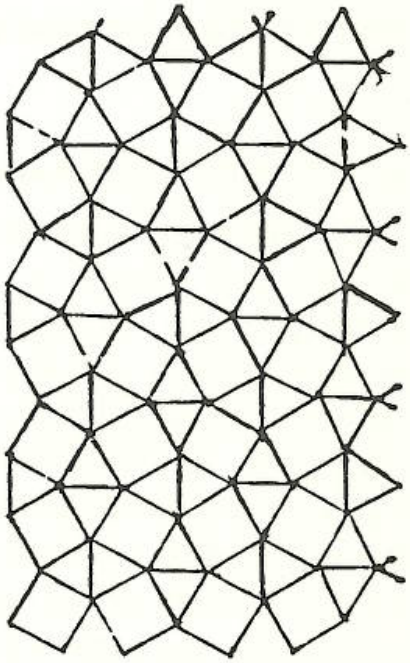
players soon learn which pentominoes are manoeuvrable. In the endgame, the number of legal moves is so reduced that precise calculation is possible (and possible in a few minutes rather than a few hours).

A greater number of trial games would beyond doubt produce a more adequate set of hints for practical play and this might enable a computer to be programmed to work out the answer to the simple question: which player wins with correct play?

Have any of our readers any suggestions?



Tessellations



ACTIVITY

How many of ten *pentominoes* (see last issue) can be used to tessellate. Prove that you can tessellate using any quadrilateral, and hence using any triangle.