MAKING WAVES

For most microcomputer users, mathematics is a boring subject that has little relevance outside the classroom. But mathematical formulae are very important in the production of computer graphics. Here we explain how to build up three-dimensional graphs by entering different mathematical functions into a program.

The very mention of sines and tangents, let alone graphs in three planes, is enough to cause fear in those glad to have escaped from school mathematics. Yet with the aid of a computer these subjects can become enjoyable, even if the principles behind them are not fully understood.

The graphic abilities of most microcomputers make them ideal for displaying graphs of mathematical equations. Most of us will find such equations meaningless when they are written out as mathematical symbols, but they produce attractive patterns when plotted in the form of a graph. Even those who hate maths may be inspired to produce their own equations after seeing these displays.

All the patterns shown here were produced on a home micro using the programs listed. They are all calculated as graphs in three dimensions. Everybody knows what an ordinary two-dimensional graph looks like. A 3-D graph is composed of several two-dimensional graphs displayed at the same time, with slight differences between each one. As computers can display images in two dimensions only, the result is not truly three-dimensional, but an illusion of depth is obtained by the way the images are formed.

The programs listed here calculate the values of an equation with two variables, X and Z. The result, Y, is calculated for many values of X and Z.

Creating Shapes
Modify the program as shown under each photograph to produce these 3D graphs
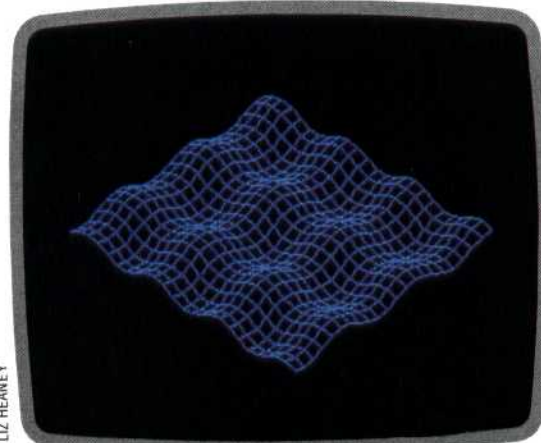
LIZ HEANEY

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170 Y=(SIN(X)+COS(Z))/60
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Each value of Y is used to plot a point on the screen, with values of Y corresponding to points on the vertical axis — i.e. the higher the value of Y, the nearer the top of the screen the point will be plotted. Neighbouring points are joined together with straight lines, giving a curved effect. The curves in one direction represent graphs of X and Y, with Z held constant, while the curves that intersect these are graphs of Y and Z, with X held constant (in this case they are plotted on the plane with axes Y and Z, which is at right angles to the X-Y plane of normal two-dimensional graphs). Such displays are useful in helping to understand complicated functions.

These displays can also be a stimulus to people who don't usually take much interest in
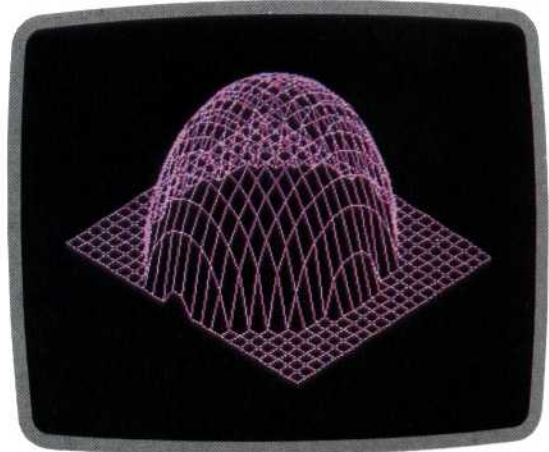

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165 C=60-X*X-Z*Z
170 Y=SQR(C*(SGN(C)+1))/45
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mathematics. It's fun (and quite difficult) to attempt to come up with an equation that results in a particular shape. To alter the displayed graph, it is necessary to change the function in line 170 of the BASIC program. Some functions may be relatively complicated, and may thus require more than one program line; if this is the case then all lines between 151 and 179 may be used.

In addition to choosing a function that results in a pleasing shape, you must take care that the values produced are not so large that the graph extends beyond the screen boundaries. To keep the display within bounds, the function may need to be divided by a large number.

Versions of this program will work on several home computers. As an aid to conversion, we have designed the program so that the first section sets up the screen display in a standard way. This means that an equation that works on one particular machine should also work on others. The second part of the program is used to store the values for plotting points on the graph. These