The program we have developed now incorporates enough information to draw hundreds of patterns. All we need to do is to change one or both loci. A simple variation is to swap SIN and COS in one of the formulae. Alternatively, you could use powers of SIN and COS (multiplying them together) to produce different effects.

```
10  REM Twisted circles
20  LET xm=256: LET ym=176: LET xc=INT
(xm/2): LET yc=INT (ym/2)
30  LET r=50
40  LET s=PI/20
50  FOR i=0 TO 2*PI STEP s
60  LET x=xc+(r+30)*COS (i): LET y=yc+
(r+30)*SIN (i): LET q=yc+r*COS
(i)
70  LET p=xc+r*SIN (i): LET q=yc+r*COS
(i)
80  INK 2: PLOT x,y: DRAW p-x,q-y
90  NEXT i
```
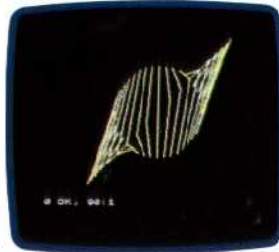
There are many variations on these ideas. A standard mathematics textbook will provide you with the formulae for creating alternative curves. However, you will probably find experimenting with your own programming a more worthwhile pastime. A few simple modifications of the program will even make the computer do the experimenting for you. The final program here cycles indefinitely through a number of randomly-generated patterns — although it will not cover all the possibilities.

```
10  REM Circle & SIN
20  LET xm=256: LET ym=176: LET xc=INT
(xm/2): LET yc=INT (ym/2)
30  LET r=50
40  LET s=PI/20
50  FOR i=0 TO 2*PI STEP s
60  LET x=xc+SIN (i)*80: LET y=yc+(r+3
0)*SIN (i)
70  LET p=xc+r*SIN (i): LET q=yc+r*COS
(i)
80  INK 2: PLOT x,y: DRAW p-x,q-y
90  NEXT i
```

```
10  REM Circle & SIN*COS
20  LET xm=256: LET ym=176: LET xc=INT
(xm/2): LET yc=INT (ym/2)
30  LET r=50
40  LET s=PI/20
50  FOR i=0 TO 2*PI STEP s
60  LET x=xc+r*SIN (i)*COS (i): LET y=
yc+r*SIN (i)*COS (i)
70  LET p=xc+r*SIN (i): LET q=yc+r*COS
(i)
80  INK 2: PLOT x,y: DRAW p-x,q-y
90  NEXT i
```

```
10  REM Random circle patterns
15  RANDOMIZE
20  LET xm=256: LET ym=176: LET xc=INT
(xm/2): LET yc=INT (ym/2)
30  LET r=60: LET s=PI/20
35  CLS
40  LET c=INT (RND*4)+1: LET d=INT (RN
D*4)+1: LET e=INT (RND*4)+1: LET f=INT (
RND*4)+1
50  FOR i=0 TO 2*PI STEP s
60  LET x=xc+r*SIN (i/c)*COS (i*d): LE
T y=yc+r*SIN (i/e)*COS (i*f)
70  LET p=xc+r*SIN (i): LET q=yc+r*COS
(i)
80  PLOT x,y: DRAW p-x,q-y
90  NEXT i
100 IF INKEY$="" THEN GO TO 100
110 GO TO 35
```

Basic Flavours

The programs listed here will run on a 16 Kbyte and 48 Kbyte Spectrum. However, converting them and using these ideas on other machines is very simple. Your micro needs high resolution graphics (preferably at least 256×176), a floating point BASIC with the functions SIN and COS, and a command to plot individual points and draw straight lines.

The first adjustments necessary are to XM and YM, the maximum X and Y values that can be plotted on your machine. Depending on the functions you use, you may find that other constants in the program, such as R and S, need to be changed. Next, you must make sure that your micro is in an appropriate graphic mode and select a colour for plotting. Finally, you need a command to draw lines between the co-ordinates given in X and Y and P and Q. On the Spectrum this has to be done with PLOT followed by DRAW. The DRAW command is complicated because on the Spectrum it is always relative to the first point plotted, whereas in this case we need to draw to a particular absolute position. Most micros have an absolute line draw function and this stage is therefore much simpler.

BBC MICRO All the BBC's modes use a grid of 1280×1024 for plotting and you should find that MODE 0 produces spectacular results. Use GCOL to select the plotting colour and MOVE and DRAW to draw the lines.

DRAGON 32/64 The Dragon's PMODE 4 provides a 256×192 grid suitable for these programs. Use SCREEN 1, 0 or SCREEN 1,1 to select either a green or buff background. The LINE command can be used (LINE (X,Y)–(P,Q),PSET) to draw the lines.

COMMODORE 64/VIC-20 These machines have suitable high resolution graphics but unfortunately do not provide appropriate commands. To run these programs, then, you need either to provide your own point and line commands or use a BASIC extension cartridge such as Simon's BASIC.

CAMPUTERS LYNX The Lynx is very suited to this sort of work as it has a full eight colour 256×248 graphics display. Like the Spectrum, this doesn't need a mode command to switch it on. Use INK to select the colour of the design and MOVE and DRAW to draw the lines.

ORIC 1/ATMOS HIRES turns on the Oric's 240×200 graphics screen. The lines can be drawn by using CURSET to move to their start point (X,Y) and then DRAW to draw the line. DRAW on the Oric is relative so the DRAW command has to be of the form DRAW p-x,q-y to work.

Design Ideas

1) Returning to the simple loop to draw a circle, we described how to create arcs and ellipses from the same program. Now see if you can find a way to draw spirals.

2) Try using other functions such as SQR and TAN to generate loci. Be warned that these functions have to be used carefully because they tend to generate awkward numbers. However, you should be able to produce some interesting results.

3) Produce animated versions of the programs. By using arrays to record the last five lines drawn, you should be able to show a group of five lines chasing each other around two loci.

4) How about creating patterns based on three loci? Make two of them very simple (perhaps a circle and a straight line) in order to keep the image uncluttered.