



```
TO DEFINE UNIT :NUMB
  DEFINE "UNIT TEXT WORD "UNIT :NUMB
END
```

We will now run the grid drawing and unit drawing parts of a pattern at the same time. A procedure called PAT lets us do this:

```
TO PAT :GRID :NUMB :PROC
  DEFINE "MOTIF TEXT :PROC
  DEFINE "R.MOTIF REWRITE :PROC
  DEFINE UNIT :NUMB
  RUN ( LIST :GRID )
  ERASE MOTIF
  ERASE R.MOTIF
  ERASE UNIT
END
```

To draw pattern 17 we would now type:

```
PAT "HEX 17 "LIT
```

This draws a hexagonal grid, with UNIT17 at each point, using LIT as the basic motif.

This method works well for all the patterns except 4, 6, 7 and 12. In these cases, the unit shape is not the same at each point, but instead undergoes a transformation (reflection, rotation, or both together). One way of dealing with this is to incorporate these transformations into the LINE and DOWN procedures. So we'll define TRANX as the transformation to be applied to the basic translation across the screen, and TRANY will be the transformation to be applied between rows. LINE and DOWN then become:

```
TO LINE :X
  REPEAT 3 [UNIT SETX XCOR XCOR + :X TRANX]
  SETX XCOR - 3 * :X
END
```

```
TO DOWN :Y :A
  SETH :A
  FD :Y
  SETH 0
  TRANY
END
```

We now define pattern 7 as:

```
TO PATTERN7 :PROC
  DEFINE "TRANX [ ] [REFLECT RT 180]
  DEFINE "TRANY [ ] [ ]
  PAT "RECT 7 :PROC
  ERASE TRANX
  ERASE TRANY
END
```

To use this, enter PATTERN7 "LEG. After running the above procedure, TRANX would have been defined as:

```
TO TRANX
  REFLECT
  RT 180
END
```

REFLECT is used to reflect the unit pattern. This procedure is defined by rewriting the UNIT

The Seventeen Plane Groups

- Key:**
P = Parallelogram lattice
R = Rectangular lattice
C = Rhombic lattice
S = Square lattice
H = Hexagonal lattice
ROS = Rotational Order of Symmetry
M = Mirror reflection
G = Glide reflection

Parallelogram

P1 (ROS = 1)

P2 (ROS = 2)

Rectangular

RM (ROS = 1)

RG (ROS = 1)

RMM (ROS = 2)

RMG (ROS = 2)

GG (ROS = 2)

Rhombic

CM (ROS = 1)

CMM (ROS = 2)

Square

S4 (ROS = 4)

S4M (ROS = 4)

S4G (ROS = 4)

Hexagonal

H3 (ROS = 3)

H3M1 (ROS = 3)

H3M2 (ROS = 3)

H6 (ROS = 6)

H6M (ROS = 6)

Lattice Begin . . .

The 17 plane patterns shown here are grouped according to their basic lattice patterns. H3M1 and H3M2, for example, are both based on a hexagonal lattice, have an order of symmetry of 3, and incorporate a mirror reflection. They differ only in that the first has an axis of reflection along the grid lines, and the second down the vertical axis