Magic Camera

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Contents

Chapter 1

Magic Camera

1.1 Magic Camera User's Guide

1.2 About the Author

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One final note...
    Please do not call me on the phone.  I work full time,
do freelance computer work, and still have to take care
```

of a house and yard. I can't afford to give telephone support at the prices I'm charging. Please contact me ONLY through the means listed above. Thank you.

1.3 About Magic Camera

Magic Camera © 1990-1994 Dan Wesnor

This project is huge. It took thousands of hours of programming, researching, and testing. I stopped counting lines of code at 12,000, and that was a long time ago.

Many thanks to the people at the SAS Institute for the best compiler I've ever used. If you program your Amiga (and I hope you do), buy it.

I hate having to do this, but having worked so hard, I feel I deserve some recognition, and if you feel the effort was good and the product useful to you, I also feel I deserve some compensation for the work I've done. So read the following to avoid any legal problems.

The rights to profit from this program belong completely to the sole author, Dan Wesnor. Remember, only the demo version is freely distributable. The registered version may only be used by the person to whom it is registered. Registration is traceable, and any "loose" copies of the registered version found on bulletin boards and so forth will be considered illegal. The registree, not the sysop, will be considered responsible for all illegally distributed copies registered under his/her name. Prosecution is always an option. Copies which cross state lines become a federal case. (The version you are using will inform you as to whether it is a demo or registered version, and who the registree is.)

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USE THIS SOFTWARE AT YOUR OWN RISK. The author assumes no liability for damages resulting from the use of this program. Period. Using this software constitutes waiver for any damages which you might incur in the process.

About This Documentation

This documentation is intended for use with AmigaGuide and compatible document readers. You can try one of the programs which converts Guide files to readable text. I've never used one, so good luck.

In short, I hate writing documentation. I'm also no good at it. I feel I made a good effort, and I detested every minute of it. Unfortunately, it shows in the text. I'll probably make several cuts at the documentation and release new versions with each new version of the code.

If you notice any bugs in the documentation, send them to me, just as you would a program bug. Hopefully, you'll find neither.

1.4 About Raytracers

A ray tracer is a program which creates highly realistic three dimensional scenes. Although a ray tracer is slow compared to other forms of 3D rendering, the basic algorithm used is simple, elegant, powerful, and quite easy to modify to produce highly realistic results. For instance, the same basic subroutines solve the problems of object visibility, local lighting (shadows), reflections, and transparency with refraction. This would explain why ray tracers are popular programs for many interested in 3D computer graphics - they are simple to write.

It seems as if the ray tracing algorithm has everything going for it: power, elegance, expandability. But there's a down side to everything. Ray tracing's primary down side is speed. A ray tracer must perform many calculations, called ray-object intersection tests. Each of these tests can involve from twenty to one hundred floating point calculations (when optimized). If a moderately detailed scene (5,000 objects) is rendered at a resolution of 640x480 pixels, then as many as 150 BILLION floating point calculations can be performed. And this doesn't include the calculations for shadows, reflections, transparency, anti-aliasing (getting the "jaggies" out), and pattern and texture mapping. Add it all up, and your computer ends up doing a lot of thinking.

So, what can't a ray tracer do. Well, in computer graphics, there is a problem that's referred to as "global lighting". Put simply, global lighting takes into account all the light in the scene. Light in a scene comes not only from sources like the lamps, but it is also reflected from every point on every object in the scene (the term "global" means just that - everything, everywhere). A ray tracer does not take this reflected light into account when computing shadows and shading. There are just too many possible light sources in a global solution. Some programmers have tried, using an algorithm called "ray bouncing", but even mediocre results slow rendering by a factor of 100 or more.

The current "great hope" of solving the global lighting problem is an algorithm called "radiosity". You may have heard this buzzword once or twice. If you've ever seen pictures generated using radiosity (especially indoor scenes), they're incredible. I would love to implement this algorithm, but unfortunately, it's just too slow, requires too much memory, and requires that the person building the scene know quite a bit about the internals of the algorithm. I have some ideas about finding some middle ground, but this is way down on my "to do" list.

If you'd like to know more about how Magic Camera implements the ray tracing algorithm, see the
Technical Description
section.

1.5 Writing Scripts

Magic Camera takes its input in the form of script files. ↩
Scripts
describe the scene which is to be rendered, including the shape and location of objects in the scene and the surface characteristics of those objects.

1.6 Scripts Writing Basics

Scripts consist of descriptions of objects, the surface characteristics of those objects, scene lighting, the arrangement of the camera, and general instructions to Magic Camera as to how the scene is to be rendered.

Scripts are stored in ASCII files, so they may be written using any text editor, or any word processor which allows files to be saved in ASCII. Scripts may also be generated by another program, such as programs which convert objects from other popular renderers into Magic Camera format.

Although scripts follow a free-format, it is always a good idea to follow a basic format so you know where everything is when you have to change the script. I usually put control statements such as `maxobcube` or `maxaadepth` at the beginning of the file. These are followed by the `camera`, then the `lamps`, and then the `sky`. After this, `patterns` and `textures` are declared, and finally, the objects themselves. More important objects, such as those that are animated or those which serve as a focal point for the scene usually come first, and the background objects last. Of course, you can organize your scripts any way you

want.

It's easier to keep track of what your script is doing by using comments. Two types of comments are allowed, C-style, and line comments. C-style comments are enclosed between '/*' and '*/', and may continue over many lines. Example:

```
/* this is a comment */
```

Line comments are initiated by a semicolon, and continue until the end of the line. They may start anywhere on the line. They may not extend past the end of the line, but more than one may be used in a row:

```
; this is a line comment
; and this is another
```

Use comments to write notes to yourself, so you can remember how a script works months from now. It prevents a lot of confusion.

Sometimes, scripts get too long to manage. In this case, you may want to break the script down into several files. To rejoin them, use the include statement:

```
include "filename"
```

Typically, I put objects in separate files, and include them into the main file. This keeps scripts uncluttered, and allows objects to be easily shared by more than one script.

Scripts consist of keywords and elements. Keywords are usually followed by a value, such as:

```
maxobcube 3
```

The value of "maxobcube" would be set to 3. Elements are more complex, and consist of a keyword followed by a list of subelements in braces ('{' and '}'). Some subelements are mandatory and must be included. Some are optional, and have default values. If you forget a mandatory subelement, the parser will tell you. Subelements, like keywords, consist of a keyword followed by a value. An example of an element declaration (this one's a sphere) is given below:

```
sphere {
    loc    <0, 5, 0>
    radius 3
    patt   red
}
```

This sphere element uses three subelements, 'loc', 'radius', and 'patt'. The subelements 'loc' and 'patt' are actually shorthand for 'location' and 'pattern'. Any time a subelement has a shorthand listed, feel free to use it to save typing. If you want, you can also use the longhand term.

In reading the descriptions of elements below, note that some subelements are surrounded by brackets ('[' and ']'). This indicates that these

subelements are optional. DO NOT INCLUDE THE BRACKETS IN THE SCRIPT. You'll get a syntax error if you do.

When subelements are referred to in context with their elements, a notation like "sphere.radius" is used. This indicates the "radius" subelement of the "sphere" element. This notation is used only by the documentation and cannot be used in scripts.

While on the subject of errors, if Magic Camera detects an error in a script, it will inform you and try to continue reading the script. Sometimes it will not be able to continue after the error. Correct the errors and run the script again.

Included in the Magic Camera package, you should have received three files, called "scan.l", "parse.y", and "defaults.c". These are the definitive definitions of the scripting language. They are also difficult to read. Scan.l contains a list of keywords that the parser recognizes, and also the regular expressions for things like
Real
numbers. Parse.y contains the grammar of the language, and will show the organization of the language, and which subelements are acceptable with which elements. Defaults.c is a definitive list of the default values for all subelements; use it as a reference. If it disagrees with other documentation you received, let me know. Defaults.c is always correct (as are all three of these files). If you learn to read these files, you may find some interesting things. Experimental features show up here, but may not be documented if they are not ready for use. If you try to use these experimental features, do so with caution. They may not work properly. That's why they're not documented.

1.7 Data Types

This section lists the various types of values that Magic ↩
Camera will
accept. It describes exactly how the types are formed. The data types accepted are:

Int

Real

Point

Vector

Color

Identifier

Filename

Text

1.8 Integer

Int denotes an integer number. For those who can read such things, the regular expression for an integer is:

```
[0-9]+
```

In English, this translates to a string of one or more digits (0-9).

Examples:

```
52    Valid.
52.0  Not Valid - Integers may not contain decimal points.
```

1.9 Real

Real denotes a real number. The regular expression is:

```
[0-9]*"."[0-9]+
```

Which means zero or more optional digits, followed by a decimal point, followed by one or more digits.

Real numbers using exponential notation may also be used:

```
[0-9]*"."[0-9]+[eE][+-]?[0-9]+
```

This more confusing regular expression simply means that any Real number may end with an "e" notation.

Also, an

```
            Int
             may be substituted anywhere a Real is used.
```

Examples:

```
11.45       Valid.
1.145e1     Valid.  Same as 11.45 above.
1.145e+1    Valid.  Same as 11.45 above.
11.45e-10   Valid.
.1145       Valid.  No leading zero required.
1145.       Invalid.  Decimal point must be followed by
            digits.
1145        Valid.
            Ints
             may be used in
            place of Reals.
11.4.5      Invalid.  Only one decimal point allowed.
```

1.10 Point

Point denotes a three dimensional point. A Point consists of three legal Real numbers contained in less-than/greater-than signs ('<' and '>') and separated by commas. The numbers are in X, Y, Z order.

Examples:

```
<1.5, -7.0, 0.3>    Valid.
<1.5,-7.0,0.3>      Valid.  Spaces not required.
<1.5, -7, .3>       Valid. '-7' and '.3' are legal
```

Real numbers.

1.11 Vector

Vector denotes a three dimensional vector. The basic definition of Vector is the same as for Point, with the exception that at least one dimension of the Vector must be non-zero.

Examples:

```
<1.5, -7, .3>    Valid.
<0, 0, 0>        Invalid.  Must have one non-zero dimension.
<0, 1.0, 0>      Valid.
```

1.12 Color

Color denotes a set of RGB values. Its basic definition is the same as for Point, except that all three values must be between 0.0 and 1.0, inclusive. The values are in red, green, blue order. Zero denotes no color, one denotes full color.

Examples:

```
<0, 0, 0>        Valid.  This would be black.
<1, 1, 1>        Valid.  White.
```

```
    <1, 0, 0>        Valid.  Red.
    <1, 1, 0>        Valid.  Yellow
    <0, 0, .5>       Valid.  A darkish blue.
    <.6, 1, .6>      Valid.  A pastel green
    <.5, -.1, .6>    Invalid.  No negative numbers.
    <.5, 1.1, .6>    Invalid.  No numbers greater than 1.0.
```

Hint: Play with a color requester (like the one found in Preferences) to find the colors you want to use.

1.13 Identifier

Identifiers (IDs) are used to name patterns, objects, and just about anything else that can be named. Once an element has been named, it is referenced by that name. The regular expression for an Identifier is:

```
[_]*[a-zA-Z]+[_.a-zA-Z0-9]*
```

This means that an Identifier consists of any number of optional leading underscores, followed by any alphabetic character, followed by any number of alphanumerics, underscores, or periods.

Examples:

```
    horse        Valid.
    _horse       Valid.
    __horse      Valid.  Any number of leading underscores may
                 be used.
    hor5se       Valid.
    hor_se       Valid.
    5horse       Invalid.  First non-underscore character must
                 be alphabetic.
    _5horse      Invalid.  First non-underscore character must
                 be alphabetic.
```

1.14 Filename

Filenames are used when a file (such as a bitmap) must be loaded. The regular expression for a filename is:

```
"[a-zA-Z0-9/'._\]+"
```

This means any string of one or more alphanumeric characters, slashes (either forward or backwards), single quotes, periods, or underscores. Note that your operating system may allow more different characters in filenames than Magic Camera will currently parse.

1.15 Text Strings

```
                    The Text data type is used primarily by the
                note
                 element.  Text consists
of any characters between double quotes (").  However, Text may not carry over
from one line to the next.

Example:

    "Boy, have we got some text here!"    Valid
```

1.16 Using Variables and Expressions

```
                    Magic Camera scripts support the use of variables.  Variables ↩
                       are used
to make managing related values easier and to allows simple animation.

    Variables make managing related values easier by allowing the value to
be specified once in the file, then used many times.  If the value changes, then
the file only needs to be changed in one place.  For example:

real sphere_radius = 5.0

sphere {
    ...
    radius    sphere_radius
    ...
}

sphere {
    ...
    radius    sphere_radius*2
    ...
}

    This example creates two spheres, one twice as big as the other.  If the
writer decides that the spheres should be larger, then he only changes the
statement

real sphere_radius = 5.0

    to

real sphere_radius = 7.5

    causing all spheres which use sphere_radius to control their size to
change.

    Variables can facilitate animation by using the built-in variables
"FRAME", "FIRSTFRAME", and "LASTFRAME".  These variable can be changed each time
the program is run (see
                Run Time Options
                ).  They may be used in calculations
involving the location or size of objects. For example:
```

```
int numframes = 20

sphere {
    loc    <0, FRAME*10.0/numframes, 0>
    ...
}
```

    In this example, the Y coordinate of the sphere is dependent on the value of FRAME. All that the user needs to do is change the value of FRAME, or FIRSTFRAME and LASTFRAME each time Magic Camera is run, and several frames will be produced in which the sphere appears to move vertically. See the demo script "balls.a" for a more complex example of using variables for animation.

Declaring Variables

    There are 6 different variable types: real, int, vector, array, slice, and path. They are described below.

Type	Description
real	same as Real
int	same as Integer
vector	a three dimensional vector
array	a one dimensional array of Reals
slice	a one dimensional array of 2D points
path	a two dimensional array of 3D points

    Variables of type "real", "int", and vector are declared by:

```
type var_name = value
```

    where type is either "real", "int", or "vector", var_name is an

Identifier
, and value is an appropriate
Real
,
Integer

```
                , or
                Vector
                 value.  All variables
MUST be initialized.
```

    Variables of type "array", "int", and "path" are defined by:

```
type var_name = { value1, value2, value3, ..., valueN }
```

    See the details on each type for examples.

```
Pre-defined Variables
---------------------

    Variable   |     Value
    -----------+------------------------
    PI         |  3.1415...
    E          |  2.718281828...
    TINY       |  An extremely small, positive value
    HUGE       |  An extremely large, positive value
    FRAME      |  Determined by
                run-time options
                    FIRSTFRAME |  Determined by
                run-time options
                    LASTFRAME  |  Determined by
                run-time options
                Expressions
-----------
```

    As you may have noticed in some examples, expressions may be used. The follow the standard order of operation for most programming languages, and should be familiar to many. For the rest of you the order is as follows:

    1. Any value or expression in parenthesis is evaluated first.
    2. Expressions are evaluated left to right.
    3. Multiplication ("*") and division ("/") are evaluated next.
    4. Addition ("+") and subtraction ("-") are evaluated last.

```
    A
                built-in function
                 or variable name may be used in any appropriate
```

place in an expression. Expressions may freely mix real and integer values. However, any expression which contains a real value ANYWHERE within it is considered a real expression, and may not be used in place of an integer.

    The expression may be used anywhere a value is accepted. An expression may be assigned to a variable by using:

```
var_name = expression
```

    For example:

```
x = 4*y
```

    which assigns the value of 4*y to the (previously declared) variable x. Expressions may be embedded in complex types such as vectors or points...

```
sphere {
    ...
    loc    <5*cos(angle), 0, 5*sin(angle)>
    ...
}
```

1.17 Declaring Reals

```
                    A variable of type real can be used anywhere a
                real number
                 may be used.
Before using a real variable, it must be declared and initialized:

real variable_name = initial_value

    where "variable_name" is an
                Identifier
                 by which the variable will be
referenced in the future and "initial value" is an expression of type
                Real
                .

Example:

real foo = 5.2
```

1.18 Declaring Ints

```
                    A variable of type int can be used anywhere a
                integer number
                 may be
used.  Before using a int variable, it must be declared and initialized:

int variable_name = initial_value

    where "variable_name" is an
                Identifier
                 by which the variable will be
referenced in the future and "initial value" is an expression of type
                Integer
                .

Example:

int foo = 5
```

1.19 Declaring Vectorss

```
                    A variable of type vector can be used anywhere a
                vector
                ,
                point
                , or
                color
                may be used.  Before using a vector variable, it must be declared ↩
                   and
initialized:

int variable_name = initial_value

    where "variable_name" is an
                Identifier
                 by which the variable will be
referenced in the future and "initial value" is a 3D value.

Example:

vector foo = <5, 4, -1>

NOTE:  Unlike the
                vector
                 type, the vector variable may have a value of all zeros
(<0,0,0>).  However, when used in place of a
                vector
                 type or
                color
                 type, the
vector variable must have an acceptable value.
```

1.20 Declaring Arrays

```
                    An array is a list of
                Real
                 values which can be referenced by an "index"
which specifies which value in the list is to be used.  To declare an array:

array array_name = { value0, value1, ..., valueN }

    where "variable_name" is an
                Identifier
                 by which the array will be
referenced in the future and "value0" through "valueN" are expressions of type

                Real
                .  Optionally, the keyword "closed" may be used as the last ↩
                   element to indicate
that the array is closed (see below).

    To reference the values stored in an array, use:
```

```
array_name[integer_expression]

    where "integer expression" is any expression of type
                Integer
                .  Note that
the first value in an array has an index of zero, so it would be referenced by:

array_name[0]

    If the array was declared using "closed", then referencing an element
beyond the last element of the array is allowed, and the index will "roll over"
to the beginning of the array.  For example, if an array is declared with 10
values, then:

array_name[15]

    is the same as

array_name[5]

    Example of a closed array:

array foo = {
    1, 2, 3, 4, 5
    closed
}


NOTE:  Currently, an array may hold only 100 values.
```

1.21 Declaring Slices

```
                    Slices are primarily used to describe cross sections of  ↩
                       objects to be
built using certain
                constructed primitives
                , such as
                spins
                 and
                extrusions
                .

    A slice is a list of 2D vectors.  To declare a slice:

slice slice_name = {
    <Xvalue0, Yvalue0>,
    <Xvalue1, Yvalue1>,
    ...,
    <XvalueN, YvalueN>
}

    where "variable_name" is an
                Identifier
```

```
                 by which the slice will be
referenced in the future and "value0" through "valueN" are expressions of type

                Real
                .  Optionally, the keyword "closed" may be used as the last  ↩
                   element to indicate
that the slice is closed (see below).  The vectors need not be put on separate
lines.  The example does so only for clarity.

    Example of a closed slice:

slice foo = {
    <1, 1>,
    <1, 0>,
    <0, 0>,
    <0, 1>
    closed
}

NOTE:  Currently, a slice may hold only 100 points.
```

1.22 Declaring Paths

```
                    A path is a list of 3D
                Points
                 which can be referenced by an "index"
which specifies which point in the list is to be used.  To declare a path:

path path_name = {
    point0,
    point1,
    ...
    pointN
}

    where "variable_name" is an
                Identifier
                 by which the path will be
referenced in the future and "point0" through "pointN" are expressions of type

                Point
                .  Optionally, the keyword "closed" may be used as the last  ↩
                   elements to indicate
that the path is closed (see below).  The points need not be put on separate
lines.  The example does so only for clarity.

    To reference the values stored in a path, use:

path_name[integer_expression]

    where "integer expression" is any expression of type
                Integer
                .  Note that
the first value in a path has an index of zero, so it would be referenced by:
```

```
path_name[0]

    If the path was declared using "closed", then referencing an element
beyond the last element of the path is allowed, and the index will "roll over"
to the beginning of the path.  For example, if an path is declared with 10
values, then:

path_name[15]

    is the same as

path_name[5]


    A path can be used anywhere a
                Point
                 or
                Vector
                 can be used, for example,
the location of a sphere:

sphere {
    loc       path_name[3]
    radius    3
    patt      red
}


    Example of a closed path:

path foo = {
    <0, 0, 0>,
    <0, 1, 0>,
    <0, 1, 1>,
    <1, 0, 0>
    closed
}

NOTE:  Currently, a path may hold only 100 values.
```

1.23 Built-in Functions

```
    The following built in functions may be used in expressions (note that
all angular values are in degrees):

    Function          |    Description
    ------------------+-------------------------------------------
    cos(degrees)      |  Returns the cosine of the angle "degrees"
    sin(degrees)      |  Returns the sine of the angle "degrees"
    tan(degrees)      |  Returns the tangent of the angle "degrees"
    acos(value)       |  Returns the arccosine of the "value"
    asin(value)       |  Returns the arcsine of the "value"
    atan(value)       |  Returns the arctangent of the "value"
```

```
    cosh(degrees)     |  Returns the hyperbolic cosine of the angle "degrees"
    sinh(degrees)     |  Returns the hyperbolic sine of the angle "degrees"
    tanh(degrees)     |  Returns the hyperbolic tangent of the angle
                      |  "degrees"
    exp(value)        |  Returns "e" to the power of "value"
    log(value)        |  Returns the natural logarithm of "value"
    log10(value)      |  Returns the base 10 logarithm of "value"
    pow(x,y)          |  Returns "x" to the power of "y"
    power(x,y)        |  Same as pow(x,y) above
    sqrt(x)           |  Returns the square root of "x"
    ceil(x)           |  Rounds "x" upwards to the nearest integer
    floor(x)          |  Truncates "x" downwards to the nearest
                      |  integer
    deg2rad(degrees)  |  Converts the value "degrees" to the
                      |  equivalent in radians
    rad2deg(radians)  |  Converts the value "radians" to the
                      |  equivalent in degrees
```

1.24 Global Scripts Elements

Setting the Camera

The Sky

Lighting the Scene

Changing the Atmosphere

Vertices

Smoothing

Anti-aliasing

Octree control

Importing Bitmaps

Annotating Scripts

Miscellaneous Flags

1.25 Setting Up the Camera

Definition:

```
camera {
```

location

```
                Point

                target

                Point
                    [
                up

                Vector
                ]
    [
                resolution

                Int

                Int
                ]
    [
                aspect

                Real
                ]
    [
                hfov

                Real
                ]
    [
                vfov

                Real
                ]
}

NOTE:  All scripts must contain a camera definition.
```

1.26 camera.location

```
                Subelement:  location
Shorthand:  loc
Data type:
                Point
                Legal values:  All values legal for
                Point
                Default value:  No default.

This subelement is mandatory.

Description:

    Positions the camera in three dimensional space.

See Also:
                camera
```

1.27 camera.target

```
                Subelement:  target
Shorthand:  None
Data type:
                Point
                Legal values:  All values legal for
                Point
                Default value:  No default

This subelement is mandatory.

Description:

    Defines the point in space which the camera looks at.  Currently, no
depth-of-field information is derived from the target, but may be in the future.

See Also:
                camera
```

1.28 camera.up

```
                Subelement:  up
Shorthand:  None
Data type:
                Vector
                Legal values:  All values legal for
                Vector
                .
    However, the "up" vector must be distinct from the direction
    the camera is pointing.
Default value:  <0, 1, 0>

This subelement is optional.

Description:

    Defines the direction which will be considered up for camera pointing
purposes only.  The "up" vector must not be parallel to the direction the camera
is pointing.

See Also:
                camera
```

1.29 camera.resolution

```
                Subelement:  resolution
Shorthand:  res
Data type:
                Int

                Int
                Legal values:  Both
                Ints
                 must be greater than or
    equal to one.
Default values:  320 400

This subelement is optional.

Description:

    Determines the resolution of the output image.  The first value
indicates the horizontal resolution, the second vertical. Values of up to 65535
are supported, but this would cause extremely time and disk space consuming
renderings.

    See Also:
                camera
```

1.30 camera.aspect

```
                Subelement:  aspect
Shorthand:  None
Data type:
                Real
                Legal values:  All positive
                Reals
                 greater than
    zero
Default value:  0.56

This subelement is optional.

Description:

    Determines pixel aspect ratio.  Pixel aspect is defined as the vertical
pixel size divided by the horizontal pixel size.  The default value is the
standard for 320x400 Amiga displays.  Here are some other values:

    320x200 Amiga:  1.12
    640x400 Amiga:  1.12
    640x200 Amiga:  2.24
    Square Pixel (320x240, 640x480, 800x600, etc.):  1.0

    Note:  If aspect is not specified and
                hfov
                 and
                vfov
```

```
                 are, the default
value for aspect is computed from those two values and the image resolution.

See Also:
                camera
```

1.31 camera.hfov

```
                Subelement:  hfov
Shorthand:  None
Data type:
                Real
                Legal values:  1.0 to 179.0, inclusive
Default value:  45.0

This subelement is optional.

Description:

    Specifies the horizontal field-of-view, in degrees.  Larger numbers
indicate wider camera shots.  Smaller numbers give a zoom effect.

    Note:  If
                vfov
                 is specified, hvof is computed from
                aspect
                 and
                vfov
                and the image resolution.

See Also:
                camera
```

1.32 camera.vfov

```
                Subelement:  vfov
Shorthand:  None
Data type:
                Real
                Legal values:  1.0 to 180.0, inclusive
Default value:  Computed

This subelement is optional.

Description:

    Specifies the vertical field-of-view, in degrees.  Larger numbers
indicate wider camera shots.  Smaller numbers give a zoom effect.

    Note:  If vfov is not specified, the default value for vfov is computed
```

```
from
                camera.hfov
                 and
                camera.aspect
                 and the image resolution.

See Also:
                camera
```

1.33 The Sky

```
                Definition:

sky {
    [
                zenith

                Color
                ]
    [
                horizon

                Color
                ]
    [
                up

                Vector
                ]
    [
                numstars

                Int
                ]
    [
                starcolor

                Color
                ]
}

NOTE:  Although all subelements are optional, there must be at least one in the
sky definition.
```

1.34 sky.zenith

```
                Subelement:  zenith
Shorthand:  None
Data type:
                Color
```

```
                Legal values:  All legal
                Color
                 values
Default value:  <0.5, 0.0, 0.5> (deep magenta)

This subelement is optional.

Description:

    Specifies the color of the sky at the zenith.  Normally the zenith is
directly overhead, but can be changed using the
                up
                 subelement of
                sky
                .

See Also:
                sky.horizon
```

1.35 sky.horizon

```
                Subelement:  horizon
Shorthand:  None
Data type:
                Color
                Legal values:  All legal
                Color
                 values
Default value:  <0.0, 0.0, 0.5> (deep blue)

This subelement is optional.

Description:

    Specifies the color of the sky at the horizon.  The horizon is defined
to be the plane passing through <0, 0, 0> and perpendicular to the
                up
                 vector of

                sky
                .

See Also:
                sky.zenith
```

1.36 sky.up

```
                Subelement:  up
Shorthand:  None
Data type:
```

```
                Vector
                Legal values:  All legal
                Vector
                 values
Default value:  <0, 1, 0>

This subelement is optional.

Description:

    Specifies the direction towards the
                zenith
                .  Note that this "up" vector
is different from
                camera.up
                .  This "up" vector is used only in computing sky
color.

See Also:
                sky

                sky.horizon
```

1.37 sky.numstars

```
                Subelement:  numstars
Shorthand:  nstars
Data type:
                Int
                Legal values:  Positive integers
Default value:  0

This subelement is optional.

Description:

    Specifies the total number of stars which should appear in the picture.

    Note:  Because of the way the stars algorithm works, stars tend to
disappear when several levels of
                anti-aliasing
                 are used.  I hope to get this
cleared up soon.

See Also:
                sky

                sky.starcolor
```

1.38 sky.starcolor

```
                Subelement:  starcolor
Shorthand:  scolor
Data type:
                Color
                Legal values:  All legal
                Color
                 values
Default value:  <1, 1, 1>

This subelement is optional.

Description:

    Specifies the brightest color which will be used for stars.  The stars
algorithm will "dim" this color to lesser values to simulate stars of different
intensities.

    Note:  Because of the way the stars algorithm works, stars tend to
disappear when several levels of
                anti-aliasing
                 are used.  I hope to get this
cleared up soon.

See Also:
                sky

                sky.numstars
```

1.39 Changing the Atmosphere

```
                Definition:

fog {
    [
                color

                Color
                ]
    [
                thinness

                Real
                ]
    [
                distance

                Real
                ]
    [
                power

                Real
                ]
```

```
}

NOTE:  Although all subelements are optional, at least one must be included in
the definition.
```

1.40 fog.color

```
                Subelement:  color
Shorthand:  None
Data type:
                Color
                Legal values:  All legal
                Color
                 values
Default value:  <0.5, 0.5, 0.5>

This subelement is optional.

Description:

    Specifies the color of fog in the picture.  The more something is
obscured by fog, the closer to this color it will become.

See Also:
                fog
```

1.41 fog.thinness

```
                Subelement:  thinness
Shorthand:  thin
Data type:
                Real
                Legal values:  Greater than zero
Default value:  1.0

This subelement is optional.

Description:

    Specifies how thick the fog will be.  Higher values decrease visibility.
 Lower values increase visibility.

See Also:
                fog
```

1.42 fog.distance

```
                Subelement:  distance
Shorthand:  dist
Data type:
                Real
                Legal values:  Greater than zero
Default value:  10.0

This subelement is optional.

Description:

    Specifies how far away the fog begins to take effect.  The fog will not
obscure any objects within this many units of the camera.

See Also:
                fog
```

1.43 fog.power

```
                Subelement:  power
Shorthand:  pow
Data type:
                Real
                Legal values:  Greater than zero
Default value:  2.0

This subelement is optional.

Description:

    Specifies how linear the fog thickness will be.  A value of 1.0
indicates that the fog will be uniformly thick over any distance, i.e. the
obscuring effect of the fog will be proportional to the distance from the
camera.  Higher values cause the fog to thicken as objects move away from the
camera.

See Also:
                fog
```

1.44 Smoothing Polygons

```
                    Objects made of polygons (triangles and parallelograms) tend ↩
                       to have a
flat look to them.  Magic Camera is capable of using a shading technique (called
"Phong shading") to give these polygons the appearance of being rounded (they
are not actually rounded, they just appear to be through optical trickery).
This gives the objects the apearance of being smooth instead of facetted.

    Enclose groups of polygons to be smoothed in between "smoothon" and
```

"smoothoff" statements. There may be more than one "smoothon"/"smoothoff" pair, but pairs may not be nested. The "smoothon" and "smoothoff" statements take no arguments.

Example:

```
smoothon

/* Polygon definitions here... */

smoothoff

smoothon

/* More polygons here ... */

smoothoff
```

All types of statements may be put between "smoothon" and "smoothoff". However, only
triangles
,
parallelograms
, and
compound objects
will be affected.
Polygons in one "smoothon"/"smoothoff" pair will be handled separately from those in other pairs.

1.45 ws_g_antialias

"Jaggies" on the edges of polygons may be smoothed by invoking ↩
the
anti-aliasing routines. Magic Camera uses an adaptive anti-aliasing algorithm which traces additional rays only when necessary. When the corners of a pixel are found to have different colors, the pixel is subdivided, and more rays are traced. If the difference can still not be resolved, the pixel is subdivided again, and so on, until either the difference is resolved or a pre-determined limit is reached.

The maximum number of subdivisions per pixel allowed is determined by the "maxaadepth" statement. The "maxaadepth" statement takes one argument, an

Int
. The value given for "maxaadepth" must be greater than zero. ↩
The default
value is one, and a value of three gives excellent anti-aliasing (at the expense of rendering time). Larger values of "maxaadepth" cause extremely time consuming ray traces without producing noticeably better results.

The difference in color which the algorithm considers to be significant is controlled by the "maxaadiff" statement. This statement takes a
Color
as its
only argument. The default value is <0.1, 0.1, 0.1>, and rarely needs to be

```
changed.

Examples:

maxaadepth 3            /* go deep... */
maxaadiff <0.3, 0.3, 0.3>    /* but only when necessary */
```

    For more information on anti-aliasing, see
                Anti-Aliasing
                 in the

                Technical Description
                section.

1.46 Controlling the Octree

```
                    Magic Camera uses a data structure called an "octree" to  ↩
                       reduce the
number of intersection tests the ray tracer needs to perform.  An octree
subdivides the three-dimensional world until either there are fewer than
"maxobcube" cubes in each division of the world, or each octant of the world has
been subdivided "maxoctdepth" times.
    The "maxoctdepth" statement takes a single
                Int
                 as its argument.  The
default value is five.  Larger numbers increase the size of the octree by as
much as eight times for each one added to the value.
    The "maxobcube" statement has one argument, a single
                Int
                .  Its default
value is two.  Larger values will build a smaller octree.
    Larger octrees may speed up ray tracing, but for some scenes, they can
actually slow processing down.  Larger octrees always use more memory.
    If the ray tracer runs out of memory while building the octree, it will
not abort.  However, an "unbalanced" octree will be built, which may cause
longer trace times.  Also, the ray tracer may need more memory after the octree
has been built.  If the octree has used all the available memory, and the ray
tracer needs more later on, the ray tracer will quit before finishing the scene.
 It's always a good idea to specify an octree which leaves at least some memory
free.

Examples:

maxobcube 5    /* good settings for low memory */
maxoctdepth 3
```

    For more information on octrees, see
                How an Octree Works
                 in the

                Technical Description
                section.

1.47 Declaring Bitmaps

When using
bitmapped patterns
and
bitmapped textures
, it is necessary to
declare bitmaps before using them. Bitmaps are stored in files on disk, and
loaded into memory when declared. Two types of file formats are recognized,
IFF
and
raw 24 bit data
.

To declare a bitmap using an
IFF
file:

```
iff filename bitmapname
```

To declare a bitmap using
raw 24 bit data
:

```
raw24 filename bitmapname
```

In both cases, the argument "filename" is of type
Filename
and the
argument "bitmapname" is of type
Identifier
. Data is loaded from a file called
"filename" and stored in a bitmap called "bitmapname". When the bitmap is
referenced in other parts of the script, it will be referenced by "bitmapname".

If the same bitmap file is used several times, it needs to be declared
only once. Using the same file in several bitmap declarations wastes memory.

Example:

```
/* load an image from the file "mapfiles/duffslabel.iff" and use it in a
spherical wrap */

iff mapfiles/duffslabel.iff duffslabel

wrapsphere foo {
    bitmap    duffslabel
    /* other wrapsphere subelements here */
}
```

```
See also:
                wrapsphere

                wrapcylinder

                wrapflat

                bumpsphere

                bumpcylinder

                bumpflat
                NOTE:  Bitmap are memory hungry.  The approximate amount of memory ↩
                    needed by a
bitmap can be computed as follows:

For 24 bit images:

    memory (bytes) = (X image size) x (Y image size) x 3

For images which are 8 bits or less deep:

    memory (bytes) = (X size) x (Y size) x (depth) / 8

Examples:

A 640 by 480 24 bit image uses:

    memory = 640 x 480 x 3 = 921,600 bytes

A 320 by 400 HAM image uses:

    memory = 320 x 400 x 6 / 8 = 96,000 bytes
    (HAM images are 6 bits deep)
```

1.48 ws_g_note

```
                    Sometimes you may want to include notes in a script and have  ↩
                       those notes
printed out as that script is executed.  A good use of this is displaying the
author's name or any copyright information.  To include notes in a script, use:

note
                Text
                For example:

note "This script by The Imagination Guys"

    The message between quotes would be displayed as the script is executed.
```

1.49 ws_g_flags

Magic Camera scripts may contain flags which cause certain features of the ray tracer to either be disabled or altered. Flags are made up of a single word and take no arguments. The following table lists Magic Camera's script flags and their functions.

noshadows	Causes shadows to not be computed
noshad	" " " " " "
notransparent	Causes no transparencies to be computed
notrans	" " " " " "
noreflect	Causes no reflections to be computed
norefl	" " " " " "
illuminate	Causes all objects to be fully lit
illum	" " " " " "

1.50 Lighting

There are two types of lamps in Magic camera, local lamps and directional lamps. Local lamps exist at a fixed location in space. Directional lamps have no fixed location. Light from directional lamps appears to have come from a source placed an infinite distance away in a given direction.

Local lamps are more powerful and offer a wider range of options. Directional lamps are "quick and dirty", allowing simple light sources to be quickly defined.

Local lamps can further be divided into three groups: simple, extended, and spotlight. Simple local lamps have no outstanding features. Extended lamps can be used to create more realistic shadows at the expense of increased trace time, and spotlights create an effect similar to that of a theater spotlight. It is possible, but not terribly useful, to create an "extended spotlight" lamp.

The definition of a local lamp is:

```
lamp {

                location

                Point
                    [
                color

                Color
                ]
    [
                distance

                Real
                ]
    [
                radius

                Real
```

```
                ]    /* for extended lamps */
    [
                numrays

                Int
                ]    /* for extended lamps */
    [
                pointat

                Point
                ]    /* for spotlights */
    [
                spread

                Real
                ]    /* for spotlights */
    [
                power

                Real
                ]    /* for spotlights */
    [
                noshad
                ]
}


The definition of a directional lamp is:

lamp {

                direction

                Vector
                    [
                color

                Color
                ]
    [
                noshad
                ]
}
```

Unless indicated above, you may not mix the definitions for local and directional lamps. In particular, the "direction" and "location" elements may not exist within the same lamp definition.

1.51 lamp.location

```
                Subelement:  location
Shorthand:  loc
Data type:
```

```
                Point
                Legal values:  All values legal for
                Point
                .
Default value:  None
```

    This subelement is mandatory for local lamps and illegal for directional lamps.

```
Description:
```

    Defines the position in three dimensional space at which the lamp is to be located.

```
See Also:
                lamp
```

1.52 lamp.color

```
                Subelement:  color
Shorthand:  None
Data type:
                Color
                Legal values:  All values legal for
                Color
                .
Default value:  <1, 1, 1>
```

    This subelement is optional for all lamps.

```
Description:
```

    Indicates the color of light emitted by the lamp. A value of <0, 0, 0> (black) is pointless since it essentially turns off the lamp.

```
See Also:
                lamp
```

1.53 lamp.spread

```
                Subelement:  spread
Shorthand:  None
Data type:
                Real
                Legal values:  greater than zero
Default value:  15.0
```

    This subelement is optional for local lamps and ineffective for directional lamps.

```
Description:

    For "spotlight" type lamps, defines the spread angle of the spotlight in
degrees.  For a value of 45.0, the lamp will emit a cone of light which is 45
degrees in angle.

    The
                pointat
                 subelement must be defined in order for "spread" to be
effective.

See Also:
                lamp

                power
```

1.54 lamp.power

```
                Subelement:  power
Shorthand:  pow
Data type:
                Real
                Legal values:  Greater than zero
Default value:  HUGE

    This subelement is optional for local lamps and ineffective for
directional lamps.

Description:

    For "spotlight" type lamps, defines how sharp the edges of the spotlight
circle will be.  Higher values increase sharpness.

See Also:
                lamp

                spread
```

1.55 lamp.radius

```
                Subelement:  radius
Shorthand:  None
Data type:
                Real
                Legal values:  Greater than or equal to zero
Default value:  0.0

    This subelement is optional for local lamps and ineffective for
directional lamps.
```

```
Description:

    Causes the lamp to be a spherical extended light source with a radius of
the given value.  If a radius other than 0.0 is specified, than
                numrays
                 controls
the number of shadow rays cast to this lamp.

    Using extended light sources will causes shadows to "soften", making
them more realistic.  However, trace time increases dramatically, just as if
several lamps were added to the scene.  This subelement is recommended for use
in final images only.

See Also:
                lamp
```

1.56 lamp.distance

```
                Subelement:  distance
Shorthand:  dist
Data type:
                Real
                Legal values:  Greater than or equal to zero
Default value:  HUGE

    This subelement is optional for local lamps and ineffective for
directional lamps.

Description:

    Specifies the distance from the lamp at which the light fades away.
Objects farther away from the source than the indicated value will not be lit by
the lamp.  Objects closer to the lamp will be more brightly lit.  The default
value of HUGE is sufficiently large to cause all objects to be fully lit in most
scenes.

See Also:
                lamp
```

1.57 lamp.numrays

```
                Subelement:  numrays
Shorthand:  nrays
Data type:
                Int
                Legal values:  Greater than zero
Default value:  1

    This subelement is optional for local lamps and ineffective for
directional lamps.
```

```
Description:

    Indicates how many rays will be traced to the lamp in order to compute
shadows.  The actual number of shadow rays per lamp is the square of the value
given; i.e., a value of 3 causes 9 rays to be cast in shadow computation for
this lamp.  The default value of one essentially cause the lamp to be a point,
rather than extended, source.

See Also:
                lamp

                radius
```

1.58 lamp.pointat

```
                Subelement:  pointat
Shorthand:  None
Data type:
                Point
                Legal values:  All values legal for
                Point
                .
Default value:  <0, 0, 0>

    This subelement is optional for local lamps and ineffective for
directional lamps.

Description:

    For "spotlight" type lamps, defines the location in three dimensional
space at which the spotlight should point.

See Also:
                lamp

                spread

                power
```

1.59 lamp.noshad

```
                Subelement:  noshad
Shorthand:  None
Data type:  None
Legal values:  None
Default value:  None

    This subelement is optional for all lamps.
```

```
Description:

    Causes no shadow computation to be done for this lamp.  Full shading
computations are still done, but no shadows will be cast by the lamp.  (Great
for rendering vampires.)

See Also:
                lamp
```

1.60 lamp.direct

```
                Subelement:  direction
Shorthand:  direct
Data type:
                Vector
                Legal values:  All values legal for
                Vector
                .
Default value:  None

    This subelement is mandatory for directional lamps and illegal for local
lamps.

Description:

    Indicates the direction in which light travels from a directional lamp.

See Also:
                lamp
```

1.61 Vertices

```
                    Some primitives, namely
                triangles
                 can be described by using named
vertices.  This form of declaration is useful in creating polygon meshes and is
most commonly used by programs which translate other object formats into Magic
Camera scripts.

To declare a named vertex:

vertex
                Identifier

                Point
                Example:

vertex vert1 <13, 2, 6>

    This will create a vertex named "vert1" at the point <13, 2, 6>.
```

Once a group of vertices is no longer needed, the "flushverts" command should be used. This frees up the memory used by all the named vertices which have been declared. The "flushverts" command takes no arguments.

1.62 Surface Characteristics

Obviously, there must be some way to control the appearance of objects which are in the scene. Magic Camera provides two basic ways in which an object's characteristics can be altered: surface color, and surface texture.

The color of a surface is controlled by pattern elements. Pattern elements can range from simple colors to procedural textures to bitmapped patterns created using your favorite paint program or scanner.

Normally, all objects appear smooth. However, this produces unrealistic images, since objects in the real world have different textures. Magic camera allows texture definitions to be attached to objects. Textures may be either procedural or bump-mapped.

1.63 Patterns

Magic Camera has very powerful pattern generation features. Patterns can be defined in heirarchial trees. This means that one pattern can be used to define how other patterns are applied. For example, a marble pattern may be used to combine two color patterns to produce a marble surface. The brick pattern may then be used to combine the resulting marble surface with another color pattern, generating a wall made up of marble bricks.

Hopefully, this diagram will help explain:

```
        brick        <---- the top level is applied to an object
          |
    -------------
    |           |
  color      marble    <---- any pattern, no matter how complex,
```

By carefully combining patterns, you can create extremely complex patterns. Use your imagination!!

There are three types of patterns used by Magic Camera: simple, procedural, and bitmapped.

Simple patterns are always on the lowest levels of pattern trees. They are the building blocks for all other pattern types. Simple patterns are define using

color

.

Procedural patterns use some type of built-in algorithm to mix other patterns. The following are Magic Camera's pre-defined procedural patterns:

check

brick

marble

wood

clouds

blotch

The last four procedural patterns can often be used to create some very interesting patterns. Remember, clouds need not be white on a blue sky (they don't even need to be on the sky!!), and wood can be so mangled as to not look even remotely like wood, if that's what you want. Play with these, and you'll find you can do some creative things with them.

Bitmapped patterns are also very useful. They can be used to put pictures on wall, create street signs, or even put labels on soda bottles. The various bit-mapped patterns all use information loaded by the

bitmap

command.

However, they differ in how the bitmap is applied to the object. The bitmap may be "stamped" onto the object using the

wrapflat

pattern. The

wrapsphere

and

wrapcylinder

patterns have more of a "shrink wrap" effect, as if a spherical or cylindrical picture were placed around the object and shrunk onto it until it fit tightly.

1.64 Pattern Name

```
                    This field is of type
                identifier
                , and "names" the pattern.  When the
pattern is attached to objects, it will be referenced by this
                identifier
                .
```

1.65 color

```
                    The color pattern is the simplest of all pattern definitions,  ↩
                       and is
used as a basis for defining all other patterns.  The format of a color
definition is:

color
                patt_name
                 {
    [
                diffuse

                color
                ]
    [
                ambient

                color
                ]
    [
                reflect

                color
                ]
    [
                filter

                color
                ]
    [
                transmit

                color
                ]
    [
                index

                real
                ]
```

```
    [
                speccoef

                real
                ]
    [
                specrefl

                real
                ]
}
```

    Please note that although no subelements are mandatory, there must be at least one subelement within the definition.

1.66 color.diffuse

```
                Subelement:  diffuse
Shorthand:  diff
Data type:
                Color
                Legal values:  All legal values for
                Color
                Default value:  <1, 1, 1>
```

    This subelement is optional.

```
Description:
```

    Defines the diffuse color of the pattern. The diffuse color is the color which the pattern appears to be when fully lit.

```
See also:
                color

                The Magic Camera Color Model
```

1.67 color.ambient

```
                Subelement:  ambient
Shorthand:  amb
Data type:
                Color
                Legal values:  All legal values for
                Color
                Default value:  <.5, .5, .5>
```

    This subelement is optional.

```
Description:
```

Defines the amount of ambient light falling on the pattern. Ambient light is light that does not appear to come from any particular light source. This represents the minimum amount of light which will fall on objects with this pattern, even if no lamps are present in the scene.

A good trick for glowing objects, such as neon signs or car tail lights, is to raise the ambient value to <1, 1, 1>, causing the pattern to glow in the dark.

See also:
color

The Magic Camera Color Model

1.68 color.reflect

Subelement: reflect
Shorthand: refl
Data type:
Color
Legal values: All legal values for Color
Default value: <0, 0, 0>

This subelement is optional.

Description:

Defines the amount of reflection in the pattern. The default (black) causes no reflections to appear on this pattern. Changing the value causes reflections to be computed, which heightens realism but also increases trace time.

See also:
color

The Magic Camera Color Model

1.69 color.filter

Subelement: filter
Shorthand: filt
Data type:
Color
Legal values: All legal values for Color
Default value: <1, 1, 1>

This subelement is optional.

Description:

Defines the filter color of the pattern. For transparent objects, this defines how much light will be filtered as rays pass through the object on a per unit length basis. The default value (white) causes all light passing through the object to be filtered if the ray travels one or more unit length inside the object.

If a pattern with a filter value of <.5, 0, 0> is applied to a sphere of radius 1.0, then rays traveling through the center of the sphere will have all red light filtered out, since the ray travels 2.0 units through the center (radius*2) and half (0.5) of the light is filtered per unit. Rays traveling through the sphere near its edges will have less red light filtered out. Other green and blue light will not be affected.

This subelement is primarily used to create more convincing shadows of transparent objects.

See also:
color

color.transmit

The Magic Camera Color Model

1.70 color.transmit

Subelement: transmit
Shorthand: trans
Data type:
Color
Legal values: All legal values for
Color
Default value: <0, 0, 0>

This subelement is optional.

Description:

Defines the color of light transmitted by the pattern. A pattern with a transmit value of <0, 0, 1> will appear as blue glass. The default value (black) makes the pattern opaque. Changing the value will increase trace time.

Note that, unlike
filter
, there is no dependence on the length of a ray passing through the object.

See also:
color

color.filter

The Magic Camera Color Model

1.71 color.index

Subelement: index
Shorthand: None
Data type:
Real
Legal values: Greater than zero
Default value: 1.0

This subelement is optional.

Description:

For transparent patterns, defines the index of refraction. The default value causes no refraction to occur. Larger values increase the amount of refraction.

Refraction, put simply, is the bending of light as it passes through a transparent object.

See also:
color

1.72 color.specrefl

Subelement: specrefl
Shorthand: srefl
Data type:
Real
Legal values: Between zero and one, inclusive
Default value: 0.5

This subelement is optional.

Description:

This is the percentage of light reflected by "specular" reflection. Higher values produce brighter "hot spots" on the pattern.

For the purposes of Magic Camera, specular reflection means reflection of the light source on the pattern. This makes a pattern appear to be shiny.

See also:
color

color.speccoef

The Magic Camera Color Model

1.73 color.speccoef

```
                Subelement:  speccoef
Shorthand:  scoef
Data type:
                Real
                Legal values:  Greater than zero
Default value:  50

    This subelement is optional.

Description:

    This element controls the "tightness" of the pattern's specular
reflection.  Higher values produce tighter "hot spots" on the pattern.

    For the purposes of Magic Camera, specular reflection means reflection
of the light source on the pattern.  This makes a pattern appear to be shiny.

See also:
                color

                color.specrefl

                The Magic Camera Color Model
```

1.74 check

```
                    This pattern produces a checkerboard type pattern, with  ↩
                       alternating
squares of two different surfaces.  The format is:

check
                patt_name
                 {

                pattern1

                Identifier

                pattern2

                Identifier
                    [
                xsize

                Real
                ]
    [
```

```
                ysize

                Real
                ]
    [
                zsize

                Real
                ]
}
```

1.75 check.pattern1, check.pattern2

```
                Subelement:  pattern1, pattern2
Shorthand:  patt1, patt2
Data type:
                Identifier
                Legal values:  The name of any previosly defined pattern
Default value:  None

    These subelements are mandatory.

Description:

    These subelements specify the alternating patterns used in the
checkerboard.

See also:
                check
```

1.76 check.xsize, check.ysize, check.zsize

```
                Subelement:  xsize, ysize, zsize
Shorthand:  None
Data type:
                Real
                Legal values:  Greater than zero
Default value:  1.0 for each

    These subelements are optional.

Description:

    These subelements specify the size of the alternating blocks in the X,
Y, and Z dimensions.

See also:
                check
```

1.77 brick

```
                    This pattern simulates a brick surface.  The format is:

brick
                patt_name
                 {
                brick
                Identifier
                mortar
                Identifier
                    [
                xsize
                Real
                ]
    [
                ysize
                Real
                ]
    [
                zsize
                Real
                ]
    [
                msize
                Real
                ]
    [
                yoffset
                Real
                ]
    [
                zoffset
                Real
                ]
}
```

1.78 brick.brick, brick.mortar

```
                Subelement:  brick, mortar
Shorthand:  None
Data type:
                Identifier
```

```
                Legal values:  The name of any previosly defined pattern
Default value:  None

    These subelements are mandatory.

Description:

    These subelements specify the patterns used for the "bricks" and the
"mortar" in the pattern.

See also:
                brick
```

1.79 brick.xsize, brick.ysize, brick.zsize

```
                Subelement:  xsize, ysize, zsize
Shorthand:  None
Data type:
                Real
                Legal values:  Greater than zero
Default value:  xsize = 1.0, ysize = 0.5, zsize = 0.5

    These subelements are optional.

Description:

    These subelements specify the size of the bricks in the X, Y, and Z
dimensions.

See also:
                brick
```

1.80 brick.msize

```
                Subelement:  msize
Shorthand:  None
Data type:
                Real
                Legal values:  Greater than zero
Default value:  0.2

    This subelement is optional.

Description:

    This subelement specifies the thickness of the mortar between the
bricks.

See also:
                brick
```

1.81 brick.yoffset, brick.zoffset

```
                Subelement:  yoffset, zoffset
Shorthand:  None
Data type:
                Real
                Legal values:  Any valid
                Real
                Default value:  yoffset = 0.5, zoffset = 0.5

    These subelements are optional.

Description:

    These subelements specify the offset between rows of bricks.  As bricks
are "stacked" in the Y dimension, each successive row is displaced in the X
dimension by "yoffset".  As bricks are "stacked" in the Z dimension, each
successive row is displaced in the X dimension by "zoffset".  Note that there is
currently no subelement called "xoffset".

See also:
                brick
```

1.82 marble

```
                    This pattern creates a rather realistic marble effect.  The ↩
                       format is:

marble
                patt_name
                 {

                pattern

                Identifier

                grain

                Identifier
                    [
                scale

                Real
                ]
    [
                power

                Real
                ]
```

```
}
```

1.83 marble.pattern, marble.grain

```
                Subelement:  pattern, grain
Shorthand:  patt, None
Data type:
                Identifier
                Legal values:  The name of any previosly defined pattern
Default value:  None

    These subelements are mandatory.

Description:

    These subelements specify the patterns used.  The pattern named by
"pattern" is the primary pattern of the marble, while the pattern named by
"grain" is used for the grain running through the marble.

See also:
                marble
```

1.84 marble.scale

```
                Subelement:  scale
Shorthand:  None
Data type:
                Real
                Legal values:  Greater than zero
Default value:  1.0

    This subelement is optional.

Description:

    This subelement changes the apparent size of the pattern on the surface
of the object.  Increasing values cause the pattern to become smaller on the
object, while decreasing values cause the pattern to become larger on the
object.

See also:
                marble
```

1.85 marble.power

```
                Subelement:  power
Shorthand:  None
Data type:
                Real
                Legal values:  Greater than zero
Default value:  1.0

    This subelement is optional.

Description:

    This subelement changes the sharpness of the transition between the
"pattern" and "grain" patterns of the marble.  It also influences the thickness
of the "grain".  Increasing values cause sharper transitions, and more "grain".
Decreasing values cause transitions to be less sharp, and less "grain" will
appear.

See also:
                marble
```

1.86 wood

```
                    Creates a simulated wood pattern.  The format is:

wood
                patt_name
                 {

                pattern

                Identifier

                grain

                Identifier
                    [
                scale

                Real
                ]
}
```

1.87 wood.pattern, wood.grain

```
                Subelement:  pattern, grain
Shorthand:  patt, None
Data type:
                Identifier
                Legal values:  The name on any previosly defined pattern
```

```
Default value:  None

    These subelements are mandatory.

Description:

    These subelements specify the patterns used.  The pattern named by
"pattern" is the primary pattern of the wood, while the pattern named by "grain"
is used for the grain running through the wood.

See also:
                wood
```

1.88 wood.scale

```
                Subelement:  scale
Shorthand:  None
Data type:
                Real
                Legal values:  Greater than zero
Default value:  1.0

    This subelement is optional.

Description:

    This subelement changes the apparent size of the pattern on the surface
of the object.  Increasing values cause the pattern to become smaller on the
object, while decreasing values cause the pattern to become larger on the
object.

See also:
                wood
```

1.89 clouds

```
                    Creates a cloud pattern.  The format is:

clouds
                patt_name
                 {

                sky

                Identifier

                clouds

                Identifier
                    [
```

```
                scale

                Real
                ]
    [
                power

                Real
                ]
    [
                perturb

                Real
                ]
    [
                xphase

                Real
                ]
    [
                yphase

                Real
                ]
    [
                zphase

                Real
                ]
}
```

1.90 clouds.sky, clouds.clouds

```
                Subelement:  sky, clouds
Shorthand:  None
Data type:
                Identifier
                Legal values:  The name of any previosly defined pattern
Default value:  None

    These subelements are mandatory.

Description:

    These subelements specify the patterns used.  The pattern named by "sky"
is the background pattern of the sky, while the pattern named by "clouds" is
used for the clouds in the sky.

See also:
                clouds
```

1.91 clouds.scale

```
                Subelement:  scale
Shorthand:  None
Data type:
                Real
                Legal values:  Greater than zero
Default value:  1.0

    This subelement is optional.

Description:

    This subelement changes the apparent size of the pattern on the surface
of the object.  Increasing values cause the pattern to become smaller on the
object, while decreasing values cause the pattern to become larger on the
object.

See also:
                clouds
```

1.92 clouds.power

```
                Subelement:  power
Shorthand:  pow
Data type:
                Real
                Legal values:  Greater than zero
Default value:  1.0

    This subelement is optional.

Description:

    This subelement causes the clouds to become more or less defined in the
sky, and also causes more or less clouds to be present.  Increasing values cause
fewer, but more sharply defined, clouds.  Decreasing values have the opposite
effect.

See also:
                clouds
```

1.93 clouds.perturb

```
                Subelement:  perturb
Shorthand:  turb
Data type:
                Real
                Legal values:  Greater than zero
Default value:  1.0
```

This subelement is optional.

Description:

This subelement changes the amount of turbulence in the clouds. Higher values cause more turbulence. Values above two or so give unrealistic results, but sometimes this is desired. Low values may cause too much repetition in the cloud pattern.

See also:
clouds

1.94 clouds.xphase, clouds.yphase, clouds.zphase

Subelement: xphase, yphase, zphase
Shorthand: None
Data type:
Real
Legal values: All valid values for
Real
Default value: 0.0

These subelements are optional.

Description:

These subelements change the phase of the sine and cosine waves used to create the clouds. By cycling one or more of these values through 360 degrees, the clouds may be animated.

See also:
clouds

1.95 wrapsphere

This pattern wraps a bitmapped image onto the object using a ↩ sphere as
the intermediate surface. The format is:

wrapsphere
patt_name
{

bitmap

Identifier

pattern

```
                Identifier
                    [
                substitute

                Integer

                Identifier
                ]
    [
                dodiffuse
                ]
    [
                dotransmit
                ]
    [
                doreflect
                ]
    [
                xrepeat

                Real
                ]
    [
                yrepeat

                Real
                ]
    [
                filter

                Integer
                ]
}

    The shorthand "wrapsp" may be used in place of "wrapsphere".

    One of [
                dodiffuse
                ], [
                dotransmit
                ], or [
                doreflect
                ] must be included.
```

1.96 wrapsphere.bitmap, wrapcylinder.bitmap, wrapflat.bitmap

```
                Subelement:  bitmap
Shorthand:  None
Data type:
                Identifier
                Legal values:  The name of any previosly defined bitmap
Default value:  None
```

```
    This subelement is mandatory.

Description:

    This subelement specifies the bitmap which is to be applied to the
object.

See also:
                wrapsphere

                wrapflat

                wrapcylinder

                Declaring Bitmaps
```

1.97 wrapsphere.pattern, wrapcylinder.pattern, wrapflat.pattern

```
                Subelement:  pattern
Shorthand:  patt
Data type:
                Identifier
                Legal values:  The name of any previosly defined pattern
Default value:  None

    This subelement is mandatory.

Description:

    This subelement specifies the pattern which is used as a basis for the
new pattern.  Since the bitmap will supply only the diffuse, transmit, and/or
reflect values of the new pattern, all other values come from the pattern
specified by this subelement.

See also:
                wrapsphere

                wrapflat

                wrapcylinder

                dodiffuse

                dotransmit

                doreflect
```

1.98 wrapsphere.substitute, wrapcylinder.substitute, wrapflat.substitute

```
                Subelement:  substitute
Shorthand:  sub
Data type:
                Integer

                Identifier
                Legal values:  Any integer greater than or equal to zero followed ↩
                   by
        the name of any previously defined pattern
Default value:  None

    This subelement is optional.

Description:

    If the bitmap uses a color look-up table (bitmaps with 256 or fewer
colors), it is possible to substitute a previously defined pattern for a color
in the look-up table.  For example:

wrapsp foo {
    ...
    sub 4 white_marble
    ...
}


    This would cause the pattern "white_marble" to be used where ever the
color specified by pen number 4 appeared in the bitmap.


See also:
                wrapsphere

                wrapflat

                wrapcylinder
```

1.99 wrapsphere.dodiffuse, wrapsphere.dotransmit, wrapsphere.doreflect

```
                Subelement:  dodiffuse, dotransmit, doreflect
Shorthand:  dodiff, dotrans, dorefl
Data type:  None
Legal values:  None
Default value:  None

    At least one of these subelements must be used.

Description:

    These subelements cause the color found in the bitmapped image to be
used for the diffuse, transmitted, or reflected color of the pattern.  These may
be used in any combination, so long as at least one appears in the defintion.
```

```
See also:
                wrapsphere

                wrapflat

                wrapcylinder
```

1.100 wrapsphere.xrepeat, wrapsphere.yrepeat

```
                Subelement:  xrepeat, yrepeat
Shorthand:  xrep, yrep
Data type:
                Real
                Legal values:  Greater than zero
Default value:  1.0

    These subelements are optional.

Description:

    These subelements control how many times the bitmap is repeated around
the sphere.  The bitmap is repeated "xrepeat" number of times around the equator
of the sphere and "yrepeat" number of times between the poles of the sphere.


See also:
                wrapsphere
```

1.101 wrapsphere.filter

```
                Subelement:  filter
Shorthand:  filt
Data type:
                Integer
                Legal values:  1, 3, 5, or 7
Default value:  3

    This subelement is optional.

Description:

    Controls the size of the filter used when applying the bitmap.  Either
no filter is used or a 3x3, 5x5, or 7x7 Gaussian filter is applied (see table).
This is necessary because aliasing occurs when mapping the bitmap from object
space to screen space.  This aliasing manifests itself in the form of jaggies
and thin lines which disappear and reappear.  Changing this values may improve
the quality of the bitmap's appearance.

    The values given cause the following filters to be used:
```

```
 value | filter
-------+-------------
   1   | no filter
   3   | 3x3 Gaussian
   5   | 5x5 Gaussian
   7   | 7x7 Gaussian
```

Since the aliasing depends on final image resolution and the possibility of magnification through reflections and transmissions by curved surfaces, the only way to find the best filter to use is by playing with the values.

See also:

wrapsphere

wrapflat

wrapcylinder

1.102 wrapflat

This pattern wraps a bitmapped image onto the object using a plane as the intermediate surface. The format is:

```
wrapflat
                patt_name
                 {

                bitmap

                Identifier

                pattern

                Identifier
                    [
                substitute

                Integer

                Identifier
                ]
    [
                dodiffuse
                ]
    [
                dotransmit
                ]
    [
                doreflect
                ]
    [
                filter
```

```
                Integer
                ]
    [
                repeatx
                ]
    [
                repeaty
                ]

                location

                Point

                xaxis

                Vector

                yaxis

                Vector
                    [
                xlength

                Point
                ]
    [
                ylength

                Point
                ]
}
```

    The shorthand "wrapfl" may be used in place of "wrapflat".

```
    One of [
                dodiffuse
                ], [
                dotransmit
                ], or [
                doreflect
                ] must be included.
```

1.103 wrapflat.location

```
                Subelement:  location
Shorthand:  loc
Data type:
                Point
                Legal values:  All legal values for
                Point
                Default value:  None
```

    This subelement is mandatory.

```
Description:

    This subelement defines the location of the plane which is used as an
intermediate surface for the pattern mapping.  This location corresponds to the
<0,0> pixel coordinate of the bitmap.


See also:
                wrapflat

                wrapflat.xaxis

                wrapflat.yaxis
```

1.104 wrapflat.xaxis, wrapflat.yaxis

```
                Subelement:  xaxis, yaxis
Shorthand:  None
Data type:
                Vector
                Legal values:  All legal values for
                Vector
                Default value:  None

    These subelements are mandatory.

Description:

    These subelements define the X and Y axes for the plane which is to be
used as the intermediate surface for the pattern mapping.  They correspond to
the X and Y axes of the bitmap used in the pattern mapping.  If
                xlength
                 or

                ylength
                are not given, then the length of these vectors also determine the ↩
                    length in
object space that the bitmap extends.


See also:
                wrapflat

                wrapflat.location
```

1.105 wrapflat.xlength, wrapflat.ylength

```
                Subelement:  xlength, ylength
Shorthand:  xlen, ylen
```

```
Data type:
                Real
                Legal values:  Greater than zero
Default value:  Computed from
                xaxis
                 and
                yaxis
                    These subelements are optional.

Description:

    These subelements define the length of the X and Y axis of the bitmap in
object space.  If these values are not specified, then they are computed from
the length of the vectors specified by
                xaxis
                 and
                yaxis
                .  Using these subelements
is usually easier than trying to compute the proper length of
                xaxis
                 and
                yaxis
                 by
hand.


See also:
                wrapflat
```

1.106 wrapflat.repeatx, wrapflat.repeaty

```
                Subelement:  repeatx, repeaty
Shorthand:  repx, repy
Data type:  None
Legal values:  None
Default value:  None

    These subelements are optional.

Description:

    If either of these flags are set, then the bitmap will be caused to
repeat along its X or Y axis (as in a wallpaper pattern).  The default action is
to not repeat the bitmap along either axis (as in a decal).


See also:
                wrapflat
```

1.107 wrapcylinder

```
                    This pattern wraps a bitmapped image onto the object using a  ↩
                       cylinder as
the intermediate surface.  The format is:

wrapcylinder
                patt_name
                 {

                bitmap

                Identifier

                pattern

                Identifier
                    [
                substitute

                Integer

                Identifier
                ]
    [
                dodiffuse
                ]
    [
                dotransmit
                ]
    [
                doreflect
                ]
    [
                xrepeat

                Real
                ]

                height

                Real
                    [
                filter

                Integer
                ]
}

    The shorthand "wrapcy" may be used in place of "wrapcylinder".

    One of [
                dodiffuse
                ], [
                dotransmit
                ], or [
                doreflect
                ] must be included.
```

1.108 wrapcylinder.xrepeat

```
                Subelement:  xrepeat
Shorthand:  xrep
Data type:
                Real
                Legal values:  Greater than zero
Default value:  1.0

    This subelement is optional.

Description:

    This subelement controls how many times the bitmap is repeated around
the circumference of the cylinder.

See also:
                wrapcylinder
```

1.109 wrapcylinder.height

```
                Subelement:  height
Shorthand:  None
Data type:
                Real
                Legal values:  Greater than zero
Default value:  None

    This subelement is mandatory.

Description:

    This subelement controls how far the bitmap extends vertically.

See also:
                wrapcylinder
```

1.110 blotch

```
                    This pattern produces a "patchwork" of other patterns.  It is ↩
                       difficult
to describe, so see some of the included sample scripts and images to get an
idea of what this pattern does.  The format is:

blotch
                patt_name
```

```
                {

                scale

                Real

                pattern

                Identifier
                }
```

1.111 blotch.scale

```
                Subelement:  scale
Shorthand:  None
Data type:
                Real
                Legal values:  Greater than zero
Default value:  1.0

    This subelement is optional.

Description:

    This subelement changes the apparent size of the pattern on the surface
of the object.  Increasing values cause the pattern to become smaller on the
object, while decreasing values cause the pattern to become larger on the
object.

See also:
                blotch
```

1.112 blotch.pattern

```
                Subelement:  pattern
Shorthand:  patt
Data type:
                Identifier
                Legal values:  The name of any previously defined pattern.
Default value:  None

    This subelement must be used at least once.  It may be repeated as many
as 32 times.

Description:

    This subelement adds a pattern to the list of those used by "blotch".
As many as 32 different patterns may be used by "blotch".

See also:
```

clouds

1.113 Textures

Like patterns, textures are used to add detail to the surfaces of objects. Unlike patterns, which essentially change the color of an object, textures control the apparent "roughness" of the object.

There are two types of textures available in Magic Camera: procedural and bump mapped. Currently, the only procedural texture available is waves. The "waves" texture gives the appearance of an undulating, wavy surface.

Bump mapped textures are similar to bit mapped patterns. The only difference is that the intensity of the pixels is used to determine the apparent height of that area of the object, instead of the pixels determining the color of the object. The three available bump mapped textures are bumpsphere, bumpcylinder, and bumpflat.

Textures do their work by "tricking" the ray tracer's shading algorithms into believing that the surface of the object is not flat. This shading trick produces the optical illusion that the surface is not flat. However, the actual surface of the object remains flat. This is obvious if the object is viewed "edge on". Because the surface distortions causes by textures are only illusions, at times textures will appear unrealistic. This will happen when they are viewed from a shallow angle (nearly edge on), when lit from certain angles, or if you try to make them appear too extreme.

1.114 Texture Name

This field is of type identifier, and "names" the texture. When the texture is attached to objects, it will be referenced by this identifier.

1.115 Waves

```
                    This texture produces a wave-like surface.  The format is:

waves
                text_name
                 {
    [
                ncenters

                Integer
                ]
    [
                scale

                Real
                ]
    [
                phase

                Real
                ]
    [
                size

                Real
                ]
}
```

    Although all subelements are optional, at least one must be present.

1.116 waves.ncenters

```
                Subelement:  ncenters
Shorthand:  None
Data type:
                Integer
                Legal values:  1 to 50
Default value:  10
```

    This subelement is optional.

```
Description:
```

    This subelement controls the complexity of the waves. Higher numbers cause more complex waves. Lower numbers cause simpler waves. Using a value of one causes a single ring of waves. Higher values increase the time required to compute the wave shapes.

```
See also:
                waves
```

1.117 waves.scale

```
                Subelement:  scale
Shorthand:  None
Data type:
                Real
                Legal values:  Greater than 0.0
Default value:  1.0

    This subelement is optional.

Description:

    This subelement controls the scale of the waves on the object.  Higher
numbers produce a smaller wave pattern.  Lower numbers have the opposite effect.

See also:
                waves
```

1.118 waves.phase

```
                Subelement:  phase
Shorthand:  None
Data type:
                Real
                Legal values:  Any value
Default value:  0.0

    This subelement is optional.

Description:

    This subelement controls the phase, in degrees, of the waves.  By
cycling this value through 360 degrees, the waves can be made to appear to
"roll".

See also:
                waves
```

1.119 waves.size

```
                Subelement:  size
Shorthand:  None
Data type:
                Real
                Legal values:  Greater than 0.0
Default value:  1.0

    This subelement is optional.
```

```
Description:

    This subelement controls the height of the waves on the object.  Higher
numbers produce taller waves.  Lower numbers have the opposite effect.

    If the is number is too far from zero, the result may become
unrealistic.  Typical values are between -1.0 and 1.0.

See also:
                waves
```

1.120 Spherical Bump Maps

```
                    This texture applies a bit map texture to the object using the ↩
                        same
geometry as
                wrapsphere
                .  The format is:

bumpsphere
                text_name
                 {

                bitmap

                Identifier
                    [
                xrepeat

                Real
                ]
    [
                yrepeat

                Real
                ]
    [
                size

                Real
                ]
}
```

The shorthand "bumpsp" is an acceptable substitution for "bumpsphere".

1.121 bumpsphere.xrepeat, bumpsphere.yrepeat

```
                Subelement:  xrepeat, yrepeat
Shorthand:  xrep, yrep
Data type:
```

```
                Real
                Legal values:  Greater than zero.
Default value:  1.0

    These subelements are optional.

Description:

    These subelements control how many times the bitmap is repeated around
the sphere.  The bitmap is repeated "xrepeat" number of times around the equator
of the sphere and "yrepeat" number of times between the poles of the sphere.

See also:
                bumpsphere
```

1.122 bumpsphere.bitmap, bumpcylinder.bitmap, bumpflat.bitmap

```
                Subelement:  bitmap
Shorthand:  None
Data type:
                Identifier
                Legal values:  Any previously defined bitmap.
Default value:  None

    This subelement is mandatory.

Description:

    This subelement defines which bitmap should be used to apply the texture
to the object.

See also:
                bumpsphere

                bumpcylinder

                bumpflat
```

1.123 bumpsphere.size, bumpcylinder.size, bumpflat.size

```
                Subelement:  size
Shorthand:  None
Data type:
                Real
                Legal values:  Greater than 0.0
Default value:  1.0

    This subelement is optional.

Description:
```

```
    This subelement controls the height of the texture on the object.
Higher numbers produce taller bumps.  Lower numbers have the opposite effect.

    If the is number is too far from zero, the results may become
unrealistic.  Typical values are between -1.0 and 1.0.

See also:
                bumpsphere

                bumpcylinder

                bumpflat
```

1.124 Cylindrical Bump Maps

```
                    This texture applies a bit map texture to the object using the ↩
                        same
geometry as
                wrapcylinder
                .  The format is:

bumpcylinder
                text_name
                 {

                bitmap

                Identifier
                    [
                xrepeat

                Real
                ]
    [
                height

                Real
                ]
    [
                size

                Real
                ]
}
```

```
    The shorthand "bumpcy" is an acceptable substitution for
"bumpcylinder".
```

1.125 bumpcylinder.xrepeat

```
                Subelement:  xrepeat
Shorthand:  xrep
Data type:
                Real
                Legal values:  Greater than zero
Default value:  1.0

    This subelement is optional.

Description:

    This subelement controls how many times the bitmap is repeated around
the circumference of the cylinder.

See also:
                bumpcylinder
```

1.126 wrapcylinder.height

```
                Subelement:  height
Shorthand:  None
Data type:
                Real
                Legal values:  Greater than zero
Default value:  None

    This subelement is mandatory.

Description:

    This subelement controls how far the bitmap extends vertically.

See also:
                bumpcylinder
```

1.127 Flat Bump Maps

```
                    This texture applies a bit map texture to the object using the ↩
                        same
geometry as
                wrapflat
                .  The format is:

bumpflat
                text_name
                 {

                bitmap
```

```
                Identifier

                size

                Real
                    [
                repeatx
                ]
    [
                repeaty
                ]

                location

                Point

                xaxis

                Vector

                yaxis

                Vector
                    [
                xlength

                Point
                ]
    [
                ylength

                Point
                ]
}
```

    The shorthand "bumpfl" is an acceptable substitution for "bumpflat".

1.128 bumpflat.location

```
                Subelement:  location
Shorthand:  loc
Data type:
                Point
                Legal values:  All legal values for
                Point
                Default value:  None
```

    This subelement is mandatory.

```
Description:
```

    This subelement defines the location of the plane which is used as an intermediate surface for the bump mapping. This location corresponds to the <0,0> pixel coordinate of the bitmap.

```
See also:
                bumpflat

                bumpflat.xaxis

                bumpflat.yaxis
```

1.129 bumpflat.xaxis, bumpflat.yaxis

```
                Subelement:  xaxis, yaxis
Shorthand:  None
Data type:
                Vector
                Legal values:  All legal values for
                Vector
                Default value:  None

    These subelements are mandatory.

Description:

    These subelements define the X and Y axes for the plane which is to be
used as the intermediate surface for the bump mapping.  They correspond to the X
and Y axes of the bitmap used in the bump mapping.  If
                xlength
                 or
                ylength
                 are
not given, then the length of these vectors also determine the length in object
space that the bitmap extends.


See also:
                bumpflat

                bumpflat.location
```

1.130 bumpflat.xlength, bumpflat.ylength

```
                Subelement:  xlength, ylength
Shorthand:  xlen, ylen
Data type:
                Real
                Legal values:  Greater than zero
Default value:  Computed from
                xaxis
                 and
                yaxis
```

These subelements are optional.

Description:

These subelements define the length of the X and Y axis of the bitmap in object space. If these values are not specified, then they are computed from the length of the vectors specified by
xaxis
and
yaxis
. Using these subelements is easier than trying to compute the proper length of
xaxis
and
yaxis
by hand.

See also:
bumpflat

1.131 bumpflat.repeatx, bumpflat.repeaty

Subelement: repeatx, repeaty
Shorthand: repx, repy
Data type: None
Legal values: None
Default value: None

These subelements are optional.

Description:

If either of these flags are set, then the bitmap will be caused to repeat along its X or Y axis (as in a wallpaper pattern). The default action is to not repeat the bitmap along either axis (as in a decal).

See also:
bumpflat

1.132 Primitive Object Types

Primitives are the basic building blocks of the objects found lying about ray traced scenes. No matter what you see, all Magic Camera scenes are filled with triangles, parallelograms, planes, spheres, and rings.

Triangles and parallelograms make up the bulk of the objects seen, although they are the least common found in scripts. Most often, they are specified indirectly by using

```
                constructed elements
                 such as boxes, spins, and
extrudes.

The primitive elements are:


                Triangles

                Parallelograms

                Planes

                Spheres

                Rings
```

1.133 pattern

```
                Subelement:  pattern
Shorthand:  patt
Data type:
                Identifier
                Legal values:  The name of any previously declared
                pattern
                Default value:  None

    This subelement is mandatory for all
                primitives
                 and all

                constructed elements
                .

Description:

    Attaches a named
                pattern
                 to a primitive.
```

1.134 texture

```
                Subelement:  texture
Shorthand:  text
Data type:
                Identifier
                Legal values:  The name of any previously declared
                texture
                Default value:  None
```

```
    This subelement is optional for all
                primitives
                 and all

                constructed elements
                .

Description:

    Attaches a named
                texture
                 to an object.
```

1.135 origin

```
                Subelement:  origin
Shorthand:  None
Data type:
                Point
                Legal values:  Any legal value for
                Point
                Default value:  None

    This subelement is optional for all
                primitives
                 and all

                constructed elements
                .

Description:

    Causes the given point to be considered the origin for
                pattern
                 and

                texture
                 computation.  If you are building an object and require no  ↩
                    discontinuities in

                patterns
                 and
                textures
                 across the boundaries of individual elements, then use the " ↩
                    origin"
statement to give them the same reference point for pattern computation.

    Normally, the origin is derived from some part of the element's
description, normally the "location" statement.  The "origin" statement
overrides this, giving better user control.
```

1.136 offtree

```
                Subelement:  offtree
Shorthand:  None
Data type:  None
Legal values:  None
Default value:  None

    This subelement is optional for all
                primitives
                 and all

                constructed elements
                .

Description:

    Occasionally, a single primitive will be so large as to interfere with

                octree
                 construction.  In this case, use the "offtree" flag to cause the  ↩
                    object to be
considered a global object and not be added to the
                octree
                .

    The only example I can give of the usefulness of this is a script I was
working on in which a spacecraft was in the foreground with a planet (a large
sphere) in the background.  The sphere was large enough to dwarf the spacecraft,
and caused the
                octree
                 to become heavily unbalanced.  I added this flag to
prevent this, and trace time was reduced considerably.

    Keep in mind that this flag causes the object to generate an intersect
test for ALL rays traced (which doesn't normally happen), so use it sparingly.
```

1.137 Triangles

```
                    The triangle primitive creates a single triangle.  Like the

                parallelogram
                 primitive, it is rarely used directly in scripts.  Its most  ↩
                    common use is by
programs which translate other object formats into Magic Camera scripts.

    There are two formats for the triangle primitive.  One uses named
vertices, the other does not.

Without named vertices:

triangle {
```

```
                location

                Point

                v1

                Vector

                v2

                Vector

                pattern

                Identifier
                    [
                texture
                ]
                Identifier
                ]
    [
                origin

                Point
                ]
    [
                offtree
                ]
}

Using named vertices:

triangle {

                p1

                Identifier

                p2

                Identifier

                p3

                Identifier

                pattern

                Identifier
                    [
                texture

                Identifier
                ]
    [
                origin
```

```
                Point
                ]
    [
                offtree
                ]
}
```

    In either case, the shorthand "tri" can be used in place of the full word "triangle"

1.138 triangle.location

```
                Subelement:  location
Shorthand:  loc
Data type:
                Point
                Legal values:  Any legal value for
                Point
                Default value:  None
```

    This subelement is mandatory.

```
Description:
```

    Defines the location of the first corner of the triangle. This point is also considered the origin for pattern and texture computation.

```
See Also:
                triangle

                origin
```

1.139 triangle.v1, triangle.v2

```
                Subelement:  v1, v2
Shorthand:  None
Data type:
                Vector
                Legal values:  Any legal value for
                Vector
                Default value:  None
```

    These subelements are mandatory.

```
Description:
```

```
    Defines the vectors from the
                location
                 of the triangle to the second and
third corners of the triangle.  Note that these are vectors, and not absolute
points.

Example:

    If the triangle to be created has the corners <3, 4, 2>, <4, 2, 1>, and
<4, 3, 3>, the
                location
                 would be <3, 4, 2>, v1 would be <1, -2, -1>, and v3
would be <1, -1, 1>.

See Also:
                triangle
```

1.140 triangle.p1, triangle.p2, triangle.p3

```
                Subelement:  p1, p2, p3
Shorthand:  None
Data type:
                Identifier
                Legal values:  Any previously declared
                vertex
                .
Default value:  None

    These subelements are mandatory.

Description:

    Defines the vertices to be used as the three corners of the triangle.
The vertex named by p1 is considered to be the origin for pattern and texture
computations.

See Also:
                triangle

                origin
```

1.141 Parallelograms

```
                    The parallelogram primitive is very similar to the
                triangle
                 primitive,
except that a four-sided parallelogram is created.  Also, the parallelogram
declaration does not allow vertex based definitions.

    When defining a parallelogram, only three points are explicitly
```

```
specified.  The fourth is computed from these three.  This is because, for
parallelograms, when three points are given, there is only one possible point
which will complete the parallelogram.

The definition:

parallelogram {

                location

                Point

                v1

                Vector

                v2

                Vector

                pattern

                Identifier
                    [
                texture
                ]
                Identifier
                ]
    [
                origin

                Point
                ]
    [
                offtree
                ]
}

    Sharp observers will note that this is exactly the same as for

                triangles
                .

    The shorthand "paragram" can be used in place of the full word
"parallelogram".  The term "quad" will also be accepted for historical reasons.
```

1.142 parallelogram.location

```
                Subelement:  location
Shorthand:  loc
Data type:
                Point
                Legal values:  Any legal value for
                Point
```

```
                Default value:  None

    This subelement is mandatory.

Description:

    Defines the location of the first corner of the parallelogram.  This
point is also considered the origin for
                pattern
                 and
                texture
                 computation.

See Also:
                parallelogram

                origin
```

1.143 parallelogram.v1, parallelogram.v2

```
                Subelement:  v1, v2
Shorthand:  None
Data type:
                Vector
                Legal values:  Any legal value for
                Vector
                Default value:  None

    These subelements are mandatory.

Description:

    Defines the vectors from the
                location
                 of the parallelogram to the second
and third corners of the parallelogram.  The fourth corner of the parallelogram
is computed by adding
                location
                , v1, and v2 together.

    Note that these are vectors, not absolute points.

Example:

    If the parallelogram to be created has the corners <3, 4, 2>, <4, 2, 1>,
<4, 3, 3>, and <5, 1, 2>, the
                location
                 would be <3, 4, 2>, v1 would be <1, -2,
-1>, and v3 would be <1, -1, 1>.

See Also:
                parallelogram
```

1.144 Planes

```
                    A plane is an infinite flat surface.  The most common use of a ↩
                        plane is
to define the "ground" or "floor" of a scene.  The definition of a plane looks
similar to that of a triangle or a parallelogram.  Note that a plane does not
have the "offtree" subelement, since a plane is infinite and therefore cannot be
bounded by an
                octree
                .

plane {

                location

                Point

                v1

                Vector

                v2

                Vector

                pattern

                Identifier
                    [
                texture
                ]
                Identifier
                ]
    [
                origin

                Point
                ]
}
```

1.145 plane.location

```
                Subelement:  location
Shorthand:  loc
Data type:
                Point
                Legal values:  Any legal value for
                Point
                Default value:  None

    This subelement is mandatory.

Description:
```

```
    Defines one point through which the plane will pass.  This point is also
considered the origin for
                pattern
                 and
                texture
                 computation.

See Also:
                plane

                origin
```

1.146 plane.v1, plane.v2

```
                Subelement:  v1, v2
Shorthand:  None
Data type:
                Vector
                Legal values:  Any legal value for
                Vector
                Default value:  None

    These subelements are mandatory.

Description:

    Defines the vectors with which the plane will be parallel.  Another way
to think of it is that the plane will pass through the points specified by

                location
                ,
                location
                 plus v1, and
                location
                 plus v2.

Example:

    If the plane to be created is to pass through the points <0, 5, 0>, <3,
4, 1>, and <2, 2, 3>, the
                location
                 would be <0, 5, 0>, v1 would be <3, -1, 1>,
and v2 would be <2, -3, 3>.

To define a ground plane:

plane {
    loc     <0, 0, 0>
    v1      <1, 0, 0>
    v2      <0, 0, 1>
    patt    ground.patt
}
```

```
See Also:
                plane
```

1.147 Spheres

```
                    Using the "sphere" element creates a "perfect" sphere (as ↩
                       opposed to a
"geometric" sphere made up of several triangles).

The definition of a sphere is:

sphere {

                location

                Point

                radius

                Real

                pattern

                Identifier
                    [
                texture
                ]
                Identifier
                ]
    [
                origin

                Point
                ]
    [
                offtree
                ]
}

Note:  A sphere cannot be rotated.  If a sphere is rotated, the
                pattern
                 or

                texture
                 attached to the sphere will not appear to rotate with the sphere ↩
                    (it will not
move at all), so the sphere will appear as if it has not rotated.  To produce
spheres which behave properly under all transformations, use
                psphere
                .
```

1.148 sphere.location

```
                Subelement:  location
Shorthand:  loc
Data type:
                Point
                Legal values:  Any legal value for
                Point
                Default value:  None

    This subelement is mandatory.

Description:

    Defines the center of the sphere.  This point is also considered the
origin for
                pattern
                 and
                texture
                 computation.

See Also:
                sphere

                origin
```

1.149 sphere.radius

```
                Subelement:  radius
Shorthand:  None
Data type:
                Real
                Legal values:  Greater than zero
Default value:  None

    This subelement is mandatory.

Description:

    Defines the radius of the sphere.

See Also:
                sphere
```

1.150 Rings

```
                    To create a ring or disk shape, use the "ring" element.

The definition of a ring is:
```

```
ring {
                location
                Point
                v1
                Vector
                v2
                Vector
                in
                Real
                out
                Real
                pattern
                Identifier
                    [
                texture
                Identifier
                ]
    [
                origin
                Point
                ]
    [
                offtree
                ]
}
```

Note: Rotating a ring has unpredictable results. If a pattern or texture is attached to the ring, the pattern or texture may appear to rotate in an unusual manner. Otherwise, the ring itself will rotate normally. Fully transformable rings can be created using the spin construct.

1.151 ring.location

```
                Subelement:  location
Shorthand:  loc
Data type:
                Point
                Legal values:  Any legal value for
                Point
                Default value:  None

    This subelement is mandatory.

Description:

    Defines the center of the ring.  This point is also considered the
origin for
                pattern
                 and
                texture
                 computation.

See Also:
                ring

                origin
```

1.152 ring.v1, ring.v2

```
                Subelement:  v1, v2
Shorthand:  None
Data type:
                Vector
                Legal values:  Any legal value for
                Vector
                Default value:  None

    These subelements are mandatory.

Description:

    Defines the vectors with which the plane on which the ring lies will be
parallel.  Another way to think of it is that the ring will lie on a plane which
will pass through the points specified by
                location
                ,
                location
                 plus v1, and

                location
                 plus v2.

Example:
```

```
    If the ring to be created is to pass through the points <0, 3, 0>and be
parallel to the plane y=0, the
                location
                 would be <0, 3, 0>, v1 would be <1, 0,
0>, and v2 would be <0, 0, 1>.

See Also:
                ring
```

1.153 ring.in, ring.out

```
                Subelement:  in, out
Shorthand:  None
Data type:
                Real
                Legal values:     "in" must be greater than or equal to zero.
        "out" must be greater than "in".
Default value:  None

    These subelements are mandatory.

Description:

    Defines the inner and outer radii or the ring.  If the inner radius is
equal to zero, a disk will be formed instead of a ring.

See Also:
                ring
```

1.154 Primitive Constructions

```
                    As you can imagine, building complex shapes from triangles can ↩
                        be a
trying task.  In order to help out, the Magic Camera parsing routines can build
some shapes for you.  These shapes include rotational solids ("lathed" objects),
extruded objects, etc.  These are the primary means of building objects using
Magic Camera.

    The types of constructed objects supported are:


                Height Fields

                Rotational Solids

                Boxes

                Extrusions

                Filled Polygons
```

Skinned Polygon Frames

Polygon Spheres

1.155 Smoothing Constructions

Subelement: smooth
Shorthand: None
Data type: None
Legal values: None
Default value: None

This subelement is optional.

Description:

This flag causes the smoothing algorithms to be applied to the construction. It is equivalent the placing the construction inside of a "smoothon/smoothoff" pair.

See Also:
Smoothing

1.156 Height Fields

A height field is used to build terrain-like objects. Essentially, a plane is built from a grid of triangles. The vertices of the triangles are the perturbed vertically from the plane according to data read in from a separate file (see
hfield.file
for the format of this file). The format for a height field is:

hfield {

location

Point

v1

Vector

v2

Vector
[
up

```
                Vector
                ]
    [
                height

                Real
                ]
    [
                floor

                Real
                ]

                file

                Filename

                pattern

                Identifier
                    [
                texture

                Identifier
                ]
    [
                origin

                Point
                ]
    [
                smooth
                ]
}
```

1.157 hfield.location

```
                Subelement:  location
Shorthand:  loc
Data type:
                Point
                Legal values: any legal value
Default value:  None

    This subelement is mandatory.

Description:

    Defines the location of the plane which is used to build the height
field.  It is similar to
                plane.location
                See Also:
                hfield
```

1.158 hfield.v1, hfield.v2

```
                Subelement:  v1, v2
Shorthand:  None
Data type:
                Vector
                Legal values: any legal value
Default value:  None

    These subelement are mandatory.

Description:

    Defines the two vectors along which lies the plane used to build the
height field.  It is similar to
                plane.v1 and plane.v2
                See Also:
                hfield
```

1.159 hfield.up

```
                Subelement:  up
Shorthand:  None
Data type:
                Vector
                Legal values: any legal value
Default value:  Computed from hfield.v1 and hfield.v2

    This subelement is optional.

Description:

    Defines the direction which is considered "up" from the plane of the
height field.  If it is not specified, it is computed to be perpendicular to the
plane (the cross product of
                hfield.v1 and hfield.v2
                ).

See Also:
                hfield
```

1.160 hfield.height

```
                Subelement:  height
Shorthand:  None
Data type:
```

```
                Real
                Legal values: any legal value
Default value:  1.0

    This subelement is optional.

Description:

    Defines the height of the height field.  This values read from

                hfield.file
                 are multiplied by this number, providing easy scaling of the ↩
                    field without
having to rewrite the (potentially large) file.  The height of any point in the
field is computed by:

    height = data * hfield.height -
                hfield.floor
                    Where "data" is the value read from
                hfield.file
                 for that point. If the
value of height is less than zero, it is set to zero.


See Also:
                hfield
```

1.161 hfield.floor

```
                Subelement:  floor
Shorthand:  None
Data type:
                Real
                Legal values: any legal value
Default value:  0.0

    This subelement is optional.

Description:

    Defines the minimum value used in the height field.  This value is
subtracted from all data points in the height field.  The height of any point in
the field is computed by:

    height = data *
                hfield.height
                 - hfield.floor

    Where "data" is the value read from
                hfield.file
                 for that point. If the
value of height is less than zero, it is set to zero.

See Also:
```

hfield

1.162 hfield.file

Subelement: file
Shorthand: None
Data type:
Filename
Legal values: the name of any existing file
Default value: None

This subelement is mandatory.

Description:

Tells the parser which file to read the height data from. All numbers in the file are ASCII, so you can create the file with a text editor. The data in the file must have the following format:

1. An integer value (dim) giving the dimension of the data. If this value is 8, then the data forms an 8x8 array.
2. Dim squared floating point values. If dim=8, then there must be 64 floating point values in the file. These values form an array, with the X dimension increasing across the rows, and the Y dimension increasing down the columns.

There are no provisions for comments in the file. An example file follows:

```
4
1.0 .7 .7 1.4
.8 .2 .2 .6
.2 .3 .4 .2
.5 .4 .6 .6
```

See Also:
hfield

1.163 Rotational Solids (Spins)

A rotational solid is an object created by spinning a shape about an axis. These are the types of objects often created on a woodworker's lathe. Any object that is circularly symmetrical can be created using the "spin" command. The format is:

```
spin {

location
```

```
                Point
                    [
                segments

                Integer
                ]

                slice

                Identifier
                    [
                start

                Real
                ]
    [
                end

                Real
                ]
    [
                rise

                Real
                ]
    [
                fillfirst
                ]
    [
                filllast
                ]

                pattern

                Identifier
                    [
                texture

                Identifier
                ]
    [
                origin

                Point
                ]
    [
                smooth
                ]
}
```

NOTE: Currently, all spins are made around the Y axis.

1.164 spin.location

```
                Subelement:  location
Shorthand:  loc
Data type:
                Point
                Legal values:  all legal values
Default value:  None

    This subelement is mandatory.

Description:

    Gives the location at which the spin is placed.  This point will be the
point at which any point <0, 0> in the given
                slice
                 is located.

See Also:
                spin
```

1.165 spin.segments

```
                Subelement:  segments
Shorthand:  segs
Data type:
                Integer
                Legal values:  greater than or equal to 3
Default value:  8

    This subelement is optional.

Description:

    Tells how many different "segments" the spin will be broken into.  Since
the spin is made from individual triangles, it has flat sides.  This subelement
determines how many flat sides there are to the spin.  Increasing this number
produces rounder looking spins, but causes more triangles to be generated,
increasing memory consumption and rendering time.

See Also:
                spin
```

1.166 spin.slice

```
                Subelement:  slice
Shorthand:  None
Data type:
                Identifier
                Legal values:  the name of any previously defined
                slice
```

```
                Default value:  None

    This subelement is mandatory.

Description:

    Gives the name of the slice which defines the shape to be rotated.  In
this slice, the first coordinate of each 2-D point indicates the radius, the
second of each pair indicates the height above (or below, for negative numbers)

                spin.location
                .

See Also:
                spin
```

1.167 spin.start, spin.end

```
                Subelement:  start, end
Shorthand:  None
Data type:
                Real
                Legal values:  all legal values, end must be larger than start
Default value:  start=0.0, end=360.0

    These subelements are optional.

Description:

    These two subelements allow spins which are not exactly 360 degrees
around.  Each takes a value in degrees of where the spin is to start or to end.
Zero degrees corresponds to the positive X axis.
    Note that the values can be greater than 360 degrees, this is
particularly useful in creating spiral shapes which spiral around for more than
one revolution.

See Also:
                spin

                spin.rise

                spin.fillfirst, spin.filllast
```

1.168 spin.rise

```
                Subelement:  rise
Shorthand:  None
Data type:
                Real
                Legal values:  all legal values
```

```
Default value:  0.0

    This subelement is optional.

Description:

    If  a value for rise is specified, spiraling shapes can be made.  As the
slice is rotated about the axis, it is shifted upwards (or downwards, for
negative values) so that the end of the spin is "rise" units higher than the
first.

See Also:
                spin
```

1.169 spin.fillfirst, spin.filllast

```
                Subelement:  fillfirst, filllast
Shorthand:  first, last
Data type:  None
Legal values:  None
Default value:  None

    These subelements are optional.

Description:

    When using
                spin.start, spin.end
                 or
                spin.rise
                , the start and end of the
spin will be unfilled, or open ended.  Specifying "fillfirst" or "filllast"
closes the starting slice or ending slice, respectively.

See Also:
                spin
```

1.170 Boxes

```
                    Sometimes you just want to create a simple box.  This is how  ↩
                       you do it:

box {

                location

                Point

                v1
```

```
                Vector

                v2

                Vector

                v3

                Vector

                pattern

                Identifier
                    [
                texture

                Identifier
                ]
    [
                origin

                Point
                ]
    [
                smooth
                ]
}
```

1.171 box.location

```
                Subelement:  location
Shorthand:  loc
Data type:
                Point
                Legal values:  All legal values
Default value:  None

    This subelement is mandatory.

Description:

    Determines the location of one corner of the box.  The other locations
are determined by
                box.v1, box.v2, and box.v3
                .

See Also:
                box
```

1.172 box.v1, box.v2, box.v3

```
                Subelement:  v1, v2, v3
Shorthand:  None
Data type:
                Vector
                Legal values:  All legal values
Default value:  None

    These subelements are mandatory.

Description:

    Determines the location of the corners of the box in relation to

                box.location
                .  The exact locations of the eight corners of the box are  ↩
                   determined by:

                                                 7--------8
    Corner 1: loc                               /|       /|
    Corner 2: loc+v1                           / |      / |
    Corner 3: loc+v2                          4--|-----6  |
    Corner 4: loc+v3                          |  |     |  |
    Corner 5: loc+v1+v2                    v3|  3-----|--5
    Corner 6: loc+v1+v3                       | /v2    | /
    Corner 7: loc+v2+v3                       |/       |/
    Corner 8: loc+v1+v2+v3                    1--------2
                                                  v1

    Note that v1, v2, and v3 do not have to be orthogonal.  That is, the box
can be slanted.


See Also:
                box
```

1.173 Filled Slices

```
                    Filling a previously defined slice is an easy way to create a  ↩
                       complex
polygon from triangles.  The format for a fill is:

fill {

                location

                Point

                slice

                Identifier
                    [
                hole
```

```
                Identifier
                ]

                xaxis

                Vector

                yaxis

                Vector

                pattern

                Identifier
                    [
                texture

                Identifier
                ]
    [
                origin

                Point
                ]
}
```

1.174 fill.location

```
                Subelement:  location
Shorthand:  loc
Data type:
                Point
                Legal values:  All legal values
Default value:  None

    This subelement is mandatory.

Description:

    Determines the location of the fill.  The point <0, 0> in
                fill.slice
                would be placed here.

See Also:
                fill
```

1.175 fill.slice

```
                Subelement:  slice
Shorthand:  None
```

```
Data type:
                Identifier
                Legal values:  Any previously defined
                slice
                Default value:  None

    This subelement is mandatory.

Description:

    Determines which slice is to be used in the fill.  This slice defines
the outline of the polygon.  The slice must have been defined using the "closed"
subelement.  The slice may not cross itself, that is, no edge of the slice may
cross any other edge of the slice.


See Also:
                fill
```

1.176 fill.hole

```
                Subelement:  hole
Shorthand:  None
Data type:
                Identifier
                Legal values:  Any previously defined
                slice
                Default value:  None

    This subelement is optional.

Description:

    This slice is used to cut a hole from inside the filled polygon.  The
slice must have been defined using the "closed" subelement.  The hole must be
completely contained within the slice being filled and may not cross itself,
that is, no edge of the hole may cross any other edge of the hole.  Currently,
only one hole may be used per fill.

See Also:
                fill
```

1.177 fill.xaxis, fill.yaxis

```
                Subelement:  xaxis, yaxis
Shorthand:  None
Data type:
                Vector
                Legal values:  All legal values
Default value:  None
```

```
    These subelements are mandatory.

Description:

    Determines the orientation of the polygon in 3D space.  The xaxis
corresponds with the first coordinate in the slice's 2D pair, the yaxis
corresponds with the second.

See Also:
                fill
```

1.178 Skinned Polygon Frames

```
                    This command will allow you to build very complex shapes in ↩
                       much the
same manner as is used to build wooden model airplanes.  Previously defined
slices are used as "forms" or "ribs", and a skin is stretched over these slices.
 The format is:

skin {

                slice

                Identifier

                Point

                Vector

                Vector

                fillfirst

                filllast

                pattern

                Identifier
                    [
                texture

                Identifier
                ]
    [
                origin

                Point
                ]
    [
                smooth
                ]
}
```

1.179 skin.slice

```
                Subelement:  slice
Shorthand:  None
Data type:
                Identifier

                Point

                Vector

                Vector
                Legal values:  Any previously define
                slice
                , any legal values for the point and
the vectors
Default value:  None
```

This subelements is mandatory. It may be repeated as many times as is necessary.

Description:

This complex subelement takes four arguments. The first is the name of a slice which is to be used as the form for this section of the skin. The second is a point which gives the location of the form in 3D space. The two vectors are the X and Y axes for on which the slice is oriented. The skin will be built over the slices in the order that they appear. At least two slices must appear. All slices must be either closed or not closed.

See Also:
skin

1.180 skin.fillfirst, skin.filllast

```
                Subelement:  fillfirst, filllast
Shorthand:  first, last
Data type:  None
Legal values:  None
Default value:  None
```

These subelements are optional.

Description:

Causes either the first and/or the last of the slices to be filled.

```
See Also:
                skin
```

1.181 Extrusions

```
                    This is a simple version of the
                skin
                 command.  It allows only one slice
to be used.  Essentially, that slice is stretched, or extruded, from two
dimensions into three.  This could be used, for example, to create a 3D font.
The format is:

extrude {

                location

                Point

                xaxis

                Vector

                yaxis

                Vector

                slice

                Identifier

                direct

                Vector

                length

                Real

                fillfirst

                filllast

                pattern

                Identifier
                    [
                texture

                Identifier
                ]
    [
                origin

                Point
```

```
                ]
    [
                smooth
                ]
}
```

1.182 extrude.location

```
                Subelement:  location
Shorthand:  loc
Data type:
                Vector
                Legal values:  All legal values
Default value:  None

    This subelement is mandatory.

Description:

    The location of the extrude.

See Also:
                extrude
```

1.183 extrude.xaxis, extrude.yaxis

```
                Subelement:  xaxis, yaxis
Shorthand:  None
Data type:
                Vector
                Legal values:  All legal values
Default value:  None

    These subelements are mandatory.

Description:

    Determines the orientation of the extrude in 3D space.

See Also:
                extrude
```

1.184 extrude.slice

```
                Subelement:  slice
Shorthand:  None
Data type:
```

```
                Identifier
                Legal values:  The name of a previously defined slice
Default value:  None

    This subelement is mandatory.

Description:

    Names the slice to be used in the extrude.

See Also:
                extrude
```

1.185 extrude.direct

```
                Subelement:  direct
Shorthand:  dir
Data type:
                Vector
                Legal values:  All legal values
Default value:  None

    This subelement is mandatory.

Description:

    Determines the direction (away from
                extrude.loc
                ) in which the extrusion
will be done.  If
                extrude.length
                 is not specified, the length of this vector
determines the length of the extrude.

See Also:
                extrude
```

1.186 extrude.length

```
                Subelement:  length
Shorthand:  len
Data type:
                Real
                Legal values:  Greater than zero
Default value:  Computed from
                extrude.direct
                    This subelement is optional.

Description:
```

```
    Determines the length of the extrusion.  If this subelement is defined,
the length of the
                extrude.direct
                 is irrelevant.

See Also:
                extrude
```

1.187 extrude.fillfirst, extrude.filllast

```
                Subelement:  fillfirst, filllast
Shorthand:  first, last
Data type:  None
Legal values:  None
Default value:  None

    These subelements are optional.

Description:

    These subelements cause either the front and/or rear faces of the
extrude to be filled.

See Also:
                extrude
```

1.188 Spheres

```
                    Using the "psphere" element creates a "geometric" sphere made ↩
                       up of
several triangles.

The definition of a psphere is:

psphere {

                location

                Point

                radius

                Real

                pattern

                Identifier

                hsegments
```

```
                Integer

                vsegments

                Integer
                    [
                texture
                ]
                Identifier
                ]
    [
                origin

                Point
                ]
    [
                offtree
                ]
    [
                smooth
                ]
}
```

1.189 psphere.location

```
                Subelement:  location
Shorthand:  loc
Data type:
                Point
                Legal values:  Any legal value for
                Point
                Default value:  None

    This subelement is mandatory.

Description:

    Defines the center of the sphere.  This point is also considered the
origin for
                pattern
                 and
                texture
                 computation.

See Also:
                psphere

                origin
```

1.190 psphere.radius

```
                Subelement:  radius
Shorthand:  None
Data type:
                Real
                Legal values:  Greater than zero
Default value:  None

    This subelement is mandatory.

Description:

    Defines the radius of the sphere.

See Also:
                psphere
```

1.191 psphere.hsegments, psphere.vsegments

```
                Subelement:  hsegments, vsegments
Shorthand: hsegs, vsegs
Data type:
                Integer
                Legal values:  3 or higher
Default value:  16, 8

    This subelement is optional.

Description:

    Defines how many division will make up the sphere.  The value of
hsegments defines the number of divisions around the equator.  The value of
vsegments defines the number of divisions between the poles.  Higher values make
better spheres but increase trace time.

See Also:
                psphere
```

1.192 Named Objects and Instancing

```
                    In order to allow animation, Magic Camera is capable of naming ↩
                        and
instancing objects.  This works by giving an object, or a group of objects, a
name, and then invoking that object by instancing it.  This allows an object to
be described once and used many times, and it allows an object to be moved,
rotated, and scaled.

    To name an object, enclose it inside an object/endobject pair:
```

```
object object_name

/* primitives and constructions here */

endobject
```

Where "object_name" is an
Identifier
which will be used as the name of
the object. All primitives and constructions inside the object/endobject pair will belong to the named object. Other elements, such as patterns and textures, may appear inside the object/endobject pair, but they will not specifically belong to that object.

When primitives and constructions appear inside an object/endobject pair, they will not be immediately added to the scene. To make them a part of the scene, they must be instanced:

```
instance object_name
```

A more complex form of instancing allows the patterns and textures to be changed:

```
instance {
    object    object_name
    subpatt    old_pattern_name new_pattern_name    /* optional, may
                                                       be repeated */
    subtext    old_texture_name new_texture_name    /* optional, may
                                                       be repeated */
}
```

Any primitive using a pattern named "old_pattern_name" will be given the pattern named "new_pattern_name". Likewise for textures. If the original object has no textures, use the texture name "NULLTEXT" for "old_texture_name".

Once an object has been named, it may be transformed before being instanced:

```
    /* move the object by the point value given */
translate object_name
                Point
                    /* scale the object */
scale object_name
                Point
                    /* rotating around the X, Y, or Z axes */
xrotate object_name
                Real
                    /* value in degrees */
yrotate object_name
                Real
                    /* value in degrees */
zrotate object_name
                Real
                    /* value in degrees */

    /* to return an object to its original state */
```

```
reset object_name
```

Transformations of an object take affect only if it appears before instancing. Use "reset" to get an object back to its original state if you intend to instance the object again. That way, you'll be sure of where the object is when it is instanced or transformed again.

When an object is transformed, its pattern and texture are not transformed with it. This causes the object to appear to move "through" the pattern/texture. To prevent this, use:

```
lockobject object_name
```

before transforming. Locking an object prevents most pattern/texture problems in transformation. However, spheres and rings may still suffer problems under rotation due to the way they are formed. If you must rotate a sphere or a ring, try building it by using the
spin
element instead.

To free up the memory used by the object after it has been instanced, use:

```
killobject object_name
```

Do not instance an object after it has been freed. This command only destroys the back-up copy of the object. Instances of the object will not be affected.

Child Objects

Child Objects

This next section explains the most powerful part of instancing objects. Imagine you've built an object which is an airplane, and you want to animate the plane. As the plane moves, the propeller spins; that is, the propeller is part of the plane, but it rotates independently of the plane. This is accomplished by using the "child" command inside of an object/endobject pair:

```
object airplane
child propeller
    /* the rest of the plane here */
endobject
```

The propeller has now become a child of the airplane. Where ever the plane goes, the propeller goes with it. But the propeller can also be transformed independently, so it can be rotated:

```
zrotate propeller 5
```

In general, any child of an object does all the same transformations as its parent does, and, in addition, does all of its own also. This is different from:

```
object airplane
instance propeller
```

```
    /* the rest of the plane */
endobject
zrotate propeller 5
```

In this example, the propeller is not a child of the airplane, it is a part of the airplane. The "zrotate" has no effect on the propeller (until it's instanced again, and then the propeller is rotate only for instances following "zrotate").

Keep in mind that, after an object has been made into a child, any transformations on that object will affect the child. So if you're using child objects, and strange transformations occur, check for transformations later in the file that could affect the child.

1.193 'Undocumented' Features

This section contains features which I consider experimental and extremely risky to use. They may not work, they may cause the renderer to crash or lock up, they may cause syntax errors, or they may do nothing at all.

You should consider this a preview of coming attractions, but don't expect them right away. Some of these are causing me a headache, which is why they're not finished.

```
Constructed Solid Geometry (CSG)
--------------------------------
```

This needs much work. It is on the priority list somewhere right after finishing this documentation.

In short, CSG allows objects to be built by adding one object to or subtracting it from another. For example, using a cylinder to drill a hole in a sphere. CSG allows very complex shapes to be built.

The basic framework for CSG is written. However, shadows and reflections do no work properly with CSG. I also need to work out how to transform and instance objects built with CSG.

Everything you need to know in order to use CSG (in its limited current implementation) is in the parser and scanner description files included in the package. If you can read these files, try CSG (on VERY simple objects) and see how it works.

1.194 Technical Description

This section of the documentation was intended to give you a better understanding of some of Magic Camera's peculiarities. It will probably end up being a mish-mash of topics that are written as they come up. In either case, it will hopefully explain why some things happen and other things don't. Most likely, it will bore you.

Topics Discussed

The Magic Camera Color Model

Anti-Aliasing

Ray-intersect Optimization Using an Octree

1.195 The Magic Camera Color Model

A rendering program's color model is the method it uses to shade the objects it renders. Typically, this model combines diffuse color, reflection, transparency, and specular reflection, and is written up in one long equation which uses lots of confusing symbols. Here is Magic Camera's long equation with lots of confusing symbols (it'll take a few paragraphs to get it all in):

color = diffuse + reflect + transmit + specular (eq. 1)

First of all, all symbols designate an RGB triplet. The equation is actually repeated three times, once each for red, green, and blue.

Second, all values are always between 0.0 and 1.0. This causes some problems, but is necessary. There is a minimum and a maximum intensity of any color that your computer can generate at each pixel. I say this causes problems because, if each of the elements of the color model can be 1.0, how can the be added together and still be guaranteed to be less than 1.0? They can't. If Magic camera ever finds a color value which is greater than 1.0, it is reset to 1.0. Solution: think a little bit when lighting scenes and specifying colors. Typically, the sum of color.diffuse, color.reflect, and color.transmit should not be too much more than 1.0. You should also consider the lamps in the scene. The intensities of all lamps added together and multiplied by the sum of all elements of the color concerned should not be much more than 1.0. I try to use 1.5 or so. To put this into an equation:

(sum of lamp.color for all lamps)
* (color.diff+color.refl+color.trans) < 1.5 or so

There's no exact maximum limit to the above equation because the lamps will not always shine on all objects with their maximum intensities.

Here's how each of the values which go into equation 1 are formed.

Diffuse

```
    ------

    When a ray hits an object, and it is determined that that object is
visible, more rays are cast to each of the lamps in order to find shadows.  (In
the case of soft shadows, many shadow rays are cast and the results are
averaged.)  This value is multiplied by the shading coefficient, which is the
dot product of the surface normal of the object and the vector from the
intersect point to the lamp.  This is done for all lamps, and these are added
together, along with
                color.ambient
                 to get the total light falling from the
surface.  This looks like:

    lamp_light = sum of (lamp.color * (surf_normal dot lamp_ray))
    total_light = sum of (lamp_light [for each non-obstructed lamp]) +
color.ambient
    diffuse = total_light * color.diffuse


    Reflect
    -------

    If a color is reflective, that is
                color.reflect
                 is not <0, 0, 0>, then a
ray is cast in the appropriate direction to see what is visible.  This ray
returns reflect_color, which is multiplied by color.reflect.

    reflect = reflect_color * color.reflect


    Transmit
    --------

    Transmit is similar to reflect, but more complex.  First you must
understand that a ray is either inside a transmissive object or not.  Rays from
the camera are always considered to be not inside of glass.  This condition is
marked by an "inglass" flag.  Every time a ray hits a transmissive surface,
"inglass" is toggled.  This allows the length that the ray travels inside of
glass to be tracked (I'll call this glass_len).

    If the surface is transmissive, that is
                color.transmit
                 is not <0, 0, 0>,
then a ray is cast to get transmit_color.  If the original (parent) ray is not
in glass, then glass_len is multiplied by
                color.filter
                .  This is subtracted from
color.transmit.  The result is then multiplied by color_transmit.  If the parent
ray is in glass, then it is leaving glass at this intersection, and color.filter
is ignored.  So:

    For rays entering glass:

    transmit = (color.transmit - (glass_len * color.filter)) *
transmit_color
```

For rays leaving glass:

transmit = color.transmit * transmit_color

Specular

This component is responsible for those shiny spots on objects. It approximates the reflection of a light source on an object.

First of all, the same ray as cast in "Shadow" above is used to determine if the light is obstructed or not. If so, nothing is done. If it is not, then a dot product is taken between the incident ray and the vector to the lamp. This result is raised to the power of
color.speccoef
, then multiplied by

color.specrefl
, and then by lamp.color. The result is:

specular = lamp.color * color.specrefl * (in_ray DOT lamp_ray)**color.speccoef

Conclusion (or should I say, Confusion)

Well, there it is, the Magic Camera color model. This is how all the elements of the
color
pattern are brought together. I hope you understood it.

1.196 Anti-Aliasing

Aliasing is a problem in computer image generation which is most commonly characterized by "jaggies", or stair step distortions along straight lines. Anti-aliasing is the process of removing and/or preventing these distortions.

Ray tracers form an image using a process called sampling (a ray, is in fact, a sample). The rays used have an infinitely small area (actually zero area), but the pixels in the final image have an extended area. That is, rays with an area of zero must be used to fill a pixel which has an area which is greater than zero. These zero-area samples must be extrapolated to form the pixels.

Matters are complicated by the fact that the edges of objects in the scene almost never line up with the edges of the pixels. Therefore, it is possible for a pixel to contain objects of more than one color. But the pixel itself can only be one color, so the best that can be done is to form a weighted average of all objects in the pixel (an object which occupies 30% of the pixels

contributes 30% to the final color of the pixel. Throw in the fact that, using patterns, an object may also be more than one color.

Given the above two paragraphs, the problem becomes one of finding exactly how much of the pixel is occupied by a given object so that the weighted average may be computed. Magic Camera does this using an anti-aliasing method called adaptive supersampling. Supersampling simply means that more than one sample is taken for each pixel. Adaptive means that these samples are taken only when necessary.

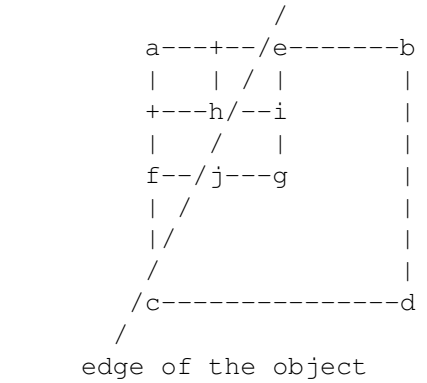
Magic Camera starts by taking one sample at each corner of the pixel, giving four samples per pixel. Using the corners of the pixel is highly efficient, since these samples may be shared with adjacent pixels. The samples are averaged, and then a check is then performed to see if one the corners of the pixel differs significantly from the average. If the difference exceeds a given amount (see

maxaadiff

), then that quadrant of the pixel is subdivided, each corner of the quadrant is sampled, the samples are averaged, and the corner samples are again compared with the average, and if necessary, the quadrant is again subdivided. This divide/sample/average/check cycle continues until either the maximum difference is not exceeded, or the pixel has been subdivided

maxaadepth

times. The following diagram applies:



Samples are taken at points a, b, c, and d. They are averaged, and point a differs by more than maxaadiff. So that quadrant is divided, sampled (points a, e, f, and g) and averaged. This time point g differs, so its quadrant is divided, sampled (h, i, j & g). Since maxaadepth would be exceeded by continuing, no further sampling is done. The average of samples g, h, i & j are used in place of point g, then a, e, f and g are averaged and used in place of point a. Points a, b, c, and d are averaged and used as the pixel color. The final color is:

```
(((a+e+f+(g+h+i+j)/4)/4)+b+c+d)/4
```

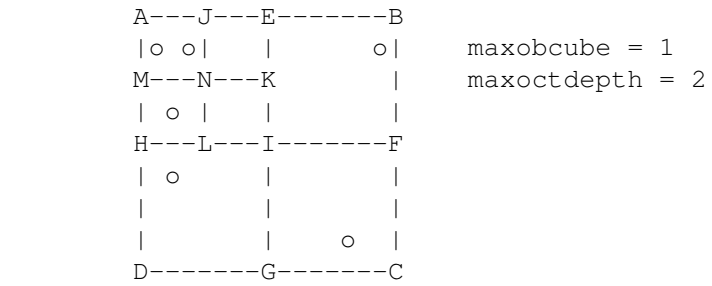
1.197 The Octree

First of all, let's compute amount of time it takes to ray ↩ trace a scene. We'll say that there are 1000 objects in the scene, and the final image will be 640 by 480 pixels. To simplify the example, we'll say that there are no shadows, reflections, or transparencies, and no anti-aliasing is done. One ray will be traced per pixel (307,200 total rays). Since, in a simple ray tracer, each ray intersects each object, there will be a total of 307,200,000 intersection tests. On a fairly quick machine (25Mhz 68030), we may get 2000 intersection tests per second. This means that the scene will take about 153,600 seconds, or about 42 hours and 20 minutes to render. Not acceptable, especially considering the simplicity of the scene (no shadows, etc.).

So how can the rendering time be decreased? Simple, decrease the number of objects in the scene (not acceptable), the resolution of the scene (not acceptable), or buy a faster computer (get your checkbook out).

Or make the ray tracer smarter. In the above example, each object is tested for intersection with each ray. However, most rays will only come close to a few objects. The ideal is to only perform intersection tests on objects which the ray will actually hit (1 test per ray). This may never be achieved, but we can sure try. The trouble is finding which objects can be intersected by the rays. This is done by a process called "object bounding." In object bounding, "bounding box" is formed around all objects in the scene. If, and only if, the ray enters the bounding box the objects inside are tested for intersection.

Magic Camera implements object bounding using data structure called an "octree". The basic process is, first a box is placed around the entire scene. If the number of objects in the box exceed a preset value (see maxobcube), then that box is evenly divided into eight smaller boxes. The number of objects inside each box is then counted, and any box which has more than maxobcube objects inside is further subdivided. This continues until either no box contains more than maxobcube objects inside, or there are maxoctdepth levels of subdivision. It is necessary to limit the number of divisions to prevent the octree from becoming too large. It is possible for the octree to expand so much that it will actually slow the rendering down (through overhead processing). This diagram shows the process in two dimensions:



First, box ABCD is created around the whole scene. There are six objects in the box ABCD (more than maxobcube), so the box is divided into four quadrants (in three dimensions, there would be eight octants formed). Quadrant AEIH still contains more than maxobcube objects, so it is divided again. Now box AJNM has two objects, still more than maxobcube, but since there have been

maxoctdepth divisions, it will not be divided.

An octree is not the ideal way to build bounding boxes, but it is a solution to the problem which works well for most cases. It has the advantage that it is adaptive, meaning that the scene is more finely divided only in areas that require finer subdivisions.

1.198 Run-time Options

ToolType Options

Options Window

Command Line Options

1.199 ToolType Options

For a description of what tooltypes are and how to change them ↩ , see your Amiga Workbench user's manual.

Tooltype options are always overridden by values read from input scripts. In otherwords, they provide a means for setting new defaults.

The following tooltypes may be used:

NOSMOOTH	Cause no polygon smoothing to be done.
FRAME	Sets a value for the FRAME script variable. If only one value follows, a single frame will be rendered. Default is 0.
FIRSTFRAME	Indicates the first frame to be rendered. If not given, will be the same as for FRAME. If different from LASTFRAME, multiple frames will be rendered. The frame number will be appended to the output file's name.
LASTFRAME	Indicates the last frame to be rendered. If not given, will be the same as for FIRSTFRAME. If different from FIRSTFRAME, multiple frames will be rendered. The frame number will be appended to the output file's name.
OUTFILE	Indicates the name of the output file. If this option is not given, the output file name is "mc.out"

```
MAXRDEPTH       Sets the maximum resolve depth for ray-tracing.
                Resolve depth is essentially the number of times
                a ray may be reflected or refracted before dying.
                Default is 6.

NOSHADOWS       Causes no shadows to be calculated.

NOREFLECT       Causes no reflections to be calculated.

NOTRANS         Causes no transparencies to be calculated.

ILLUMINATE      Causes all objects to appear fully illuminated.

HOLD            Causes Magic Camera to pause before exiting.
                MC will wait for the closewindow box to be
                clicked before exiting.  Use this in
                conjuntion with NOTRACE to examine the
                preview window.

NOTRACE         MC will not render the scene.  Use this to see
                the preview only.

XRES            Sets the X resolution of the image.
                Overrides
                camera.res
                .

YRES            Sets the Y resolution of the image.
                Overrides
                camera.res
                .

MAXOCTDEPTH     Sets the maximum octree depth.  Overrides

                maxoctdepth
                .  Default is 5.

MAXOBCUBE       Sets the maximum number of objects per
                octree cube.  Overrides
                maxoxcube
                .
                Default is 2.

MAXAADEPTH      Sets the maximum depth for adaptive anit-
                aliasing.  Overrides
                maxaadepth
                .
                Default is 1.

HFOV            Sets the horizontal field-of-view.  Overrides

                camera.hfov
                .  Default is
                45 degrees.

VFOV            Sets the vertical field-of-view.  Overrides
```

```
                camera.vfov
                .  Default is
                computed from hfov, aspect, and image resoultion.

ASPECT          Sets the pixel aspect ratio.  Overrides

                camera.aspect
                .  Default is 0.56
                (320x400 interlaced mode).

SQUARE          Sets the pixel aspect ratio to 1.0, and the
                image resolution to 640x480.  These are
                common settings for square-pixel images.

LACE            Sets the pixel aspect and resolution to create
                a 320x400 interlaced Amiga image.

NOLACE          Sets the pixel aspect and resolution to create
                a 320x200 non-interlaced Amiga image.

HIRES           Sets the pixels aspect and resoultion to create
                a 640x200 non-interlaced Amiga image.

HIRESLACE       Sets the pixel aspect and resolution to create
                a 640x400 interlaced Amiga image.

OUTPUT          Sets the format of the output file.  Accepted values
                are
                RAW
                , "QRT" (output format same
                as from the popular qrt ray-tracer), or "IFF24", for
                24bit IFF.ILBM output (default).
```

1.200 Command Line Options

```
                Usage:
------

mc [-nosmooth] [-frame frameno | -frame firstframe lastframe]
    [-quiet] [-terse] [-verbose] [-o outputfile]
    [-rd resolve_depth] [-ns] [-nr] [-nt] [-il] [-hold]
    [-r xres yres] [-notrace] [-mod maxoctdepth]
    [-moc maxobcube] [-aa maxaadepth] [-hfov horizfov]
    [-vfov vertfov] [-fov horizfov vertfov]
    [-aspect aspect_ratio] [-square] [-lace] [-nolace]
    [-out outputformat]

    Running Magic Camera from the command line without any options will
cause the options window to be used.

    In the case where an option is entered twice on the command line, the
latter occurence of the option will take precidence, as is the case with
conflicting options (i.e. -quiet -verbose).
```

```
    Command line options always override any values found in input scripts.

Option Description
------------------

-nosmooth     Cause no polygon smoothing to be done

-frame        Sets a value for the FRAME script variable.  If
              only one value follows, a single frame will be
              rendered.  If two values are given, they indicate
              the first and last frame to be rendered, and
              multiple frames will be rendered.  The frame number
              will be appended to the output file's name.
              FIRSTFRAME and LASTFRAME are also set by this option.
              Default is 0.

-quiet        MC will only print error messages.

-terse        MC will print only necessary messages.
              This is default.

-verbose      MC will become quite chatty, telling you
              more than you probably want to know.

-o            Indicates the name of the output file.  If this
              option is not given, the output file name is
              "mc.out"

-rd           Sets the maximum resolve depth for ray-tracing.
              Resolve depth is essentially the number of times
              a ray may be reflected or refracted before dying.
              Default is 7.

-ns           Causes no shadows to be calculated.

-nr           Causes no reflections to be calculated.

-nt           Causes no transparencies to be calculated.

-il           Causes all objects to appear fully illuminated.

-hold         Causes Magic Camera to pause before exiting.
              MC will wait for a carriage return at the
              command line before exiting.  Use this in
              conjuntion with -notrace to examine the
              preview window.

-notrace      MC will abort before rendering the scene.

-r            Sets the X and Y resolution of the image.
              Overrides
                camera.res
                .
              Default is 320x400.

-mod          Sets the maximum octree depth.  Overrides
```

```
                maxoctdepth
                .
              Default is 5.

-moc          Sets the maximum number of objects per
              octree cube.  Overrides
                maxoxcube
                .
              Default is 2.

-aa           Sets the maximum depth for adaptive anit-
              aliasing.  Overrides
                maxaadepth
                .
              Default is 1.

-hfov         Sets the horizontal field-of-view.  Overrides

                camera.hfov
                .
              Default is 45 degrees.

-vfov         Sets the vertical field-of-view.  Overrides

                camera.vfov
                .
              Default is computed from hfov, aspect, and
              image resolution.

-fov          Sets the horizontal and vertical field-of-view.
              Overrides both
                camera.hfov
                .
              and
                camera.vfov
                .

-aspect       Sets the pixel aspect ratio.  Overrides

                camera.aspect
                .
              Default is 0.56 (Amiga 320x400 interlace).

-square       Sets the pixel aspect ratio to 1.0, and the
              image resolution to 640x480.  These are
              common settings for square-pixel images.

-lace         Sets the pixel aspect and resolution to create
              a 320x400 interlaced Amiga image.  This is
              default.

-nolace       Sets the pixel aspect and resolution to create
              a 320x200 non-interlaced Amiga image.

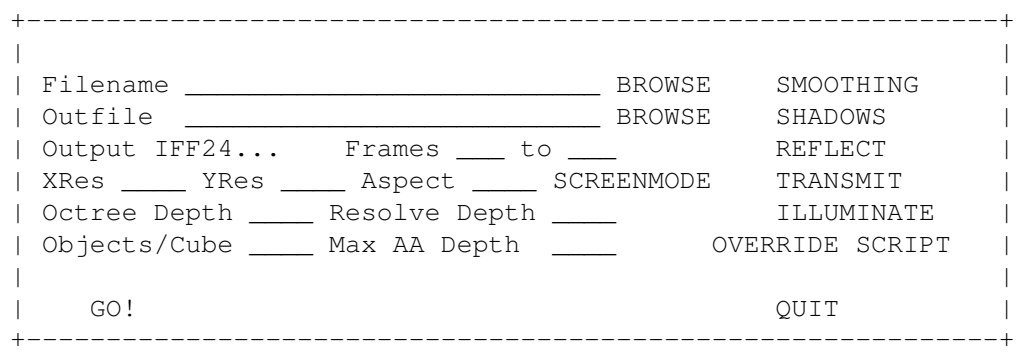
-hires        Sets the pixels aspect and resoultion to create
              a 640x200 non-interlaced Amiga image.
```

-hireslace Sets the pixel aspect and resolution to create a 640x400 interlaced Amiga image.

-out Sets the format of the output file. Accepted values are
RAW
, "QRT" (output format same as from the popular qrt ray-tracer), or "IFF24", for 24bit IFF.ILBM output (default).

1.201 Options Window

The options window looks like this...



Underscores (____) indicate a text entry gadget, ALL CAPS indicates a button gadget.

The gadgets mean:

Filename The filename of the script to read. Hit browse to get an ASL file requester (if your version of AmigaDOS supports ASL file requesters).

Outfile The filename of the output file. Hit browse to get an ASL file requester (if your version of AmigaDOS supports ASL file requesters).

Output Selects between 24 bit IFF files, QRT output files, or MC's own raw 24 output format.

Frames Indicates starting and ending framenumbers. For use with animated scripts.

XRes, YRes, Aspect Indicates the properties of the rendered image. See
Camera
Screen Mode Allows the use of the ASL screen mode requester to select the XRes, YRes, and Aspect values. Available only if you have the proper verison

```
              of the ASL libraries.

Octree Depth, Fine tunes the
                Octree
                .
Objects/Cube

Resolve Depth Sets the resolve depth, which is the maximum
              number of reflect/transmit generations a
              primary ray may generate.

Max AA Depth  See
                Anti-Aliasing
                Soothing,     Perform the same functions as the
                global flags
                .
Shadows,
Reflect,
Transmit,
Illuminate

Override Script  When selected, causes options window values
                 to override any values found in the input
                 script file.

Go!              Start tracing!

Quit             Exit without doing anything.
```

1.202 RGB

RGB stands for red, green, and blue. This is the color model used by Magic Camera (and most other programs which use color). In RGB various amounts of red, green, and blue light are mixed to form different shades of color.

1.203 IFF Files

IFF stand for Interchange File Format, and is the file format used by almost all Amiga programs to store bitmapped image data. IFF bitmaps come in several flavors, including 24 bit, HAM, and color table (32 color, 16 color, etc.) images. Magic Camera currently understands the following type of IFF images:

```
    24 bit
    HAM8 (AGA Mode)
    HAM
    Halfbright
    256 color
    128 color
    64 color
```

```
    32 color
    16 color
    8 color
    4 color
    2 color
```

Magic camera doesn't understand the special effects, such as masking planes, etc., used in some IFF files.

1.204 misc_raw24

Magic Camera can read raw 24 bit bitmaps stored in a special file format. If you have to write your own program to convert bitmaps for use by Magic Camera, it will be easier to convert the bitmaps into this format than to 24 bit IFF.

The Raw24 format used by Magic Camera is:

1. The first 4 bytes are an unsigned long specifying the X dimension of the image (pixels per row). Bytes are stored in MSB first (Motorola) order.

2. The second 4 bytes are an unsigned long specifying the Y dimension of the image (number of rows). Bytes are stored in MSB first (Motorola) order.

3. The remaining data consists of triplets of unsigned bytes which contain the RGB data. These triplets are written by rows, so that all pixels of the first row are written (in increasing X order) before the second row is written. Rows are written in increasing Y order. The first pixel written (0, 0) is the upper left hand corner of the image. The following pseudo-code applies:

```
    for y = 0 to num_rows
        for x = 0 to pix_per_row
            write red
            write green
            write blue
        next x
    next y
```