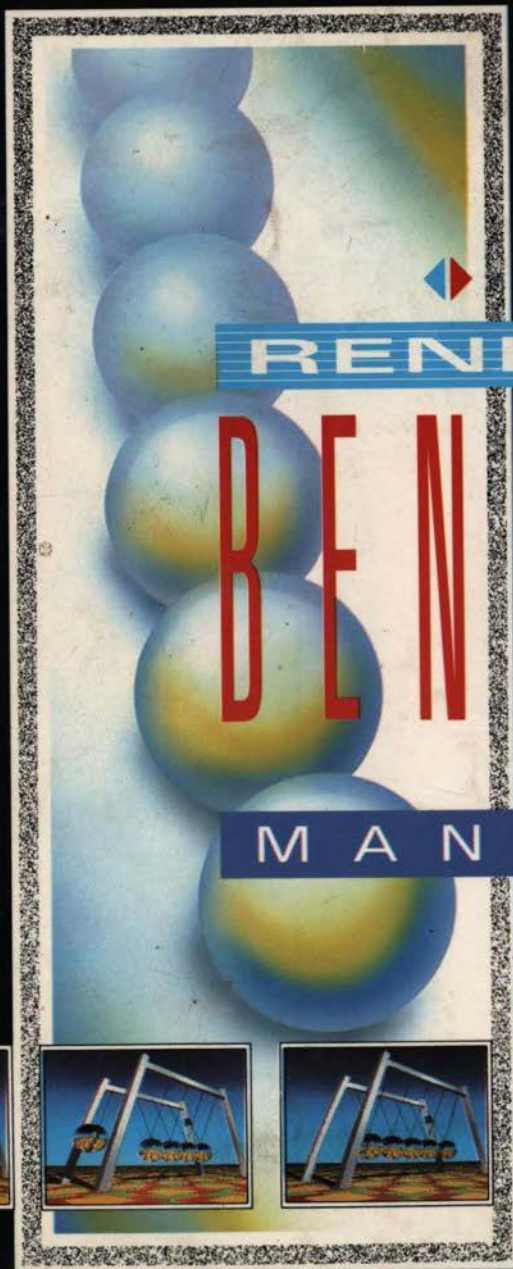


C L A R E S



RENDER

BENDER

MANUAL



3 • Dimensional Graphics Animation

SERIAL NO.

00014918



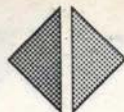
[Faint, illegible text visible through the paper, likely bleed-through from the reverse side of the page.]

[Faint, illegible text visible through the paper, likely bleed-through from the reverse side of the page.]

[Faint, illegible text visible through the paper, likely bleed-through from the reverse side of the page.]

[Faint, illegible text visible through the paper, likely bleed-through from the reverse side of the page.]

[Faint, illegible text visible through the paper, likely bleed-through from the reverse side of the page.]



CLARES

BENDER

BENDER

3 Dimensional Graphics Animation

Written by

David Hoskins

© Copyright Clares Micro Supplies 1989

All rights reserved. No part of this manual or of the computer programs to which it relates may be reproduced or transmitted in any form whatsoever or by any means electronic, mechanical or otherwise without the prior written consent of CLARES MICRO SUPPLIES.

Whilst CLARES have endeavoured to ensure that this program will perform correctly, no responsibility is accepted by CLARES relating to this program. As we have no control over the use made of the program no warranty is given or should be implied as to the suitability of the programs described in this manual for any particular application. No liability can be accepted for any consequential loss or damage, however caused, arising as a result of the use of this program.



Clares Micro Supplies

98, Middlewich Road

Northwich

Cheshire

CW9 7DA

Tel. 0606 48511

Typeset by

Catalyst Publishing

Stratford-upon-Avon

Warwickshire



CONTENTS

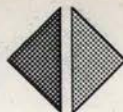
PAGE

INTRODUCTION

Introduction and Overview	1
What is Ray Tracing?	1
Animation	2
Displaying the Results	2
Terminology	3
Keywords	4
Making a Backup Disc	5
Loading the Program	6
Hard Disc	6
Running From a Hard Disc	7
Possible Problems When Booting	8
Floppy Disc	8
Hard Disc	8
RISC OS	9
Auto-Booting	9
Installing on a Hard Disc Using RISC OS	9
Exit	9
Getting Started	10
Render Bender - The Ray Tracing Program	11

THE EDITOR

Load a Scene	15
Entering The Editor	16
Mouse	16
Key Controls	17



CONTENTS

PAGE

The Editor Icons	18
Go Back	18
Compile Scene	18
List Objects	18
Clear Text	18
Insert/Overlay Mode	18
Example 1	20
Main Menu Icons	23
Ray Trace	23
Scene	23
Save	23
Load	25
Picture Size	26
Resolution	26
Select Floor	26
Floor Scale	28
Example 2	28
Sky Colour	28
Sky Depth	29
Ground	30
Example 3	30
Shadows	31
Opaque Density	31
Example 4	32
Opaque R. Index	32
Example 5	33
Lens	33
Lamp Average	34
*Prompt	35
Load Picture	35
Convert To Screensave	36
Screen On	37
Not Saving Pictures	37
First/Last	37
Example 6	38



CONTENTS PAGE

THE DELTA ANIMATOR

Delta Animator Icons	41
Prompt Panel	41
Load Picture Files	42
Clear All	43
Compile Animation	43
See Animation	43
Save Animation	44
Load Animation	45
Example 7	45
Use With Multiple Discs	46
Possible Errors	46
Example 8	47
Example 9	48
Loading Animations Into Your Own Programs	49
Animating Standard Screens	51
Points to Ponder	52

APPENDIX I

Scene Description Language	53
Co-ordinates	54
Commands	55
Light Sources	56
Example 10	57
Objects	58
Sphere	59
Pyramid	60
Box	60
Discs	61
Cones	61
Tubes	62
Polygons	62
Rotate	63
Animation	64



CONTENTS

PAGE

APPENDIX II

Errors

65

INDEX

69



INTRODUCTION AND OVERVIEW

Render Bender is a powerful 3D animation package that enables you to construct scenes using three dimensional objects and advanced Ray Tracing algorithms.



WHAT IS RAY TRACING?

It sounds complicated, but it in fact is very simple. If you create a Ray Traced picture, each pixel on the screen takes all relevant light sources and reflections into account - The resulting picture is absolutely correct according to the laws of physics and optics. All shadows, reflections (and refractions) are correctly calculated, even if light is reflected off several surfaces! The picture that you create is exactly as it would appear if you created the scene using real objects and light sources.

Imagine this - each picture that you create is a scene which is viewed through a camera lens. The position and angle of the camera can be altered as well as the focal length of the lens. You can also select the sky colours, depth of image, surface patterns, create matt or shiny objects, glass or metal finishes, or 'mirror' objects, with many other control options available for your pleasure.



ANIMATION

Variables can be introduced into a scene definition to automatically create picture sequences. Each new scene is correctly drawn with all shadows, light sources and reflections re-calculated to accurately depict that scene. Once you have set up the scene with the variables, the program automatically creates, then saves each frame in turn.

When all the frames have been stored, the animation routine is used to create the final sequence. The animation program takes each frame and compiles it into a block of program code which provides the final animated sequence.

DISPLAYING THE RESULTS

Once the animated sequence has been created, you can run it using a very simple BASIC program. Then add sound (as in our demonstration discs) or even a still frame at the start, to introduce your animated motion picture production.

NOTE:

Due to the complex nature of Ray Tracing we do not attempt to explain the theories and concepts involved.

To do this would require a large book full of technical jargon and theories. The most important piece of advice we can give you regarding both Ray Tracing and **Render Bender** is- *Experiment!*

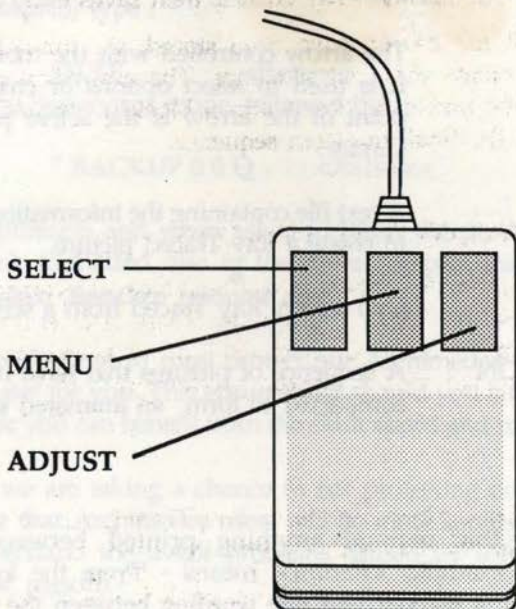
The discs supplied have lots of examples for you to examine and alter. If you use a small picture size you will soon see the effect that changing various parameters has.

One final piece of advice - *only change one parameter at a time unless you know what the effect will be.*

We think you will be more than pleased with the variety of effects and the scope **Render Bender** gives your artistic and imaginative powers, and would be interested to see your results - happy rendering and bending!

TERMINOLOGY

The use of mouse buttons in **Render Bender** follow the Acorn convention of 'SELECT', 'MENU' and 'ADJUST' for the left, middle and right buttons respectively:

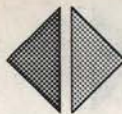


In this manual the following instruction words have these meanings:

SELECT (ING) Move the pointer to the relevant icon and Press **SELECT** to select the option.

ADJUST (ING) Move the pointer to the relevant icon and Press **ADJUST**.

CLICK ON Move the pointer to the relevant icon and Press **SELECT** to select the option or toggle the icon.



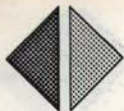
KEY WORDS

The following key words are found throughout the manual and are explained here to clarify their meaning.

- | | |
|-----------------------|---|
| CURSOR | The movable on-screen icon used to select options. |
| POINTER | The arrow controlled with the mouse. It is used to select options or colours - the point of the arrow is the active part of the Cursor. |
| SCENE | A text file containing the information required to create a Ray Traced picture. |
| PICTURE | One screen, Ray Traced from a scene file. |
| ANIMATION FILE | A sequence of pictures that have been compacted to form an animated sequence. |

NOTE:

Throughout this manual anything printed between angled brackets, for example, *<Return>*, means - 'Press the key on the keyboard that is marked with the wording between the brackets'.



MAKING A BACKUP DISC

Before using the **Render Bender** disc you should make a "back-up" copy for everyday use - and then put the original disc away for safe keeping. First prepare a blank formatted 3.5 inch disc. Place the **Render Bender** system disc in drive 0 and (if you are in BASIC) type :

QUIT <Return>

- to enter the Supervisor mode, followed by:

* BACKUP 00 Q <Return>

Follow the prompts and when asked to insert the destination disc put the blank formatted disc in the drive. Repeat this sequence for the **Render Bender** resource disc.

We have decided not to copy protect our Archimedes software to make life easier for you. This ensures that should you later upgrade to a hard disc you can benefit from the extra speed and convenience.

(Of course, we are taking a chance in not protecting our software, but we hope that Archimedes users will be more sophisticated and able to understand the major problems caused by software theft, for whatever reason).

So please, do not pass copies of this software around your friends, colleagues, or school, as it will only result in higher prices for all. After all, why should you pay higher prices so that your friends can have free software?

Incidentally, each program has a coded number to match your copy's serial number and if we discover pirate copies we *will* take legal action. We are sure that as a responsible individual you will not need to worry about this.

Please make sure that you return your registration card as we are unable to provide support or upgrades unless you are registered. The serial number **MUST** be quoted on all communications about Archimedes software. No low cost upgrades will be available unless you have returned your registration card...



LOADING THE PROGRAM

To run **Render Bender** from a floppy disc, insert the disc in drive 0 and press <Shift><Break> (This is done by holding down the <Shift> key whilst pressing and releasing <Break> before finally releasing <Shift>). This process is called 'Auto-Booting' and will become a familiar operation after using it a few times.

Auto-booting is the preferred method of running **Render Bender** from floppy disc. If you want to use the desktop you should catalogue the disc (see your Archimedes manual for details) and click on the !BOOT file. This runs the program as if you had used <Shift><Break>. The advantage of using either of these options is that the machine is returned to its original state when you exit **Render Bender**.



!BOOT

HARD DISC

If you have a hard disc fitted to your Archimedes you can run **Render Bender** from this. To transfer **Render Bender** files to your hard disc place the **Render Bender** disc in drive 0 and type:

```
*DIR :0      <Return>
*INSTALL    <Return>
```

You are asked which drive you want to use, 4 or 5 - This is usually 4, unless you have two hard discs. Next you are asked for the directory in which you want **Render Bender** to reside; we suggest you use 'RENDER' - Remember to press <Return> after answering each question. We suggest you do not copy your resource disc onto your hard disc as it will simply fill your directories.

NOTE:

The system disc contains a file called 'ReadMe' which contains up to date information. To read this file insert the working copy of your **Render Bender** disc in drive 0 and type:

```
*DIR :0.!RENDER <Return>
*TYPE ReadMe    <Return>
```



RUNNING FROM A HARD DISC

When installation is completed, you can run **Render Bender** from the hard disc by typing:

```
*RENSET <Return>
*RENDER <Return>
```

The first command runs the set-up program which configures the Archimedes correctly for **Render Bender** and then carries out a hard break to activate the configurations. The second command, ***RENDER**, runs **Render Bender** itself.

After exiting **Render Bender** you can restore the original configurations by typing:

```
*RENDRESET <Return>
```

If you want to run **Render Bender** from the hard disc using the desktop, you must enter the LIBRARY directory and click on the file 'RENSET'. This sets the configurations and performs a hard break. You must re-enter the LIBRARY directory and click on 'RENDER' to run **Render Bender**.

NOTE:

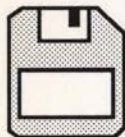
If you have installed **Render Bender** on your hard disc, please ignore references to the 'System Disc' throughout this manual, as the 'System Disc' files are now installed on your hard disc.

If you are asked to insert the 'System Disc' in drive 0 to load a file, just click on the hard disc icon instead.



POSSIBLE PROBLEMS WHEN BOOTING

FLOPPY DISC



If you get the error '**Channel at line xxx**' when auto-booting a floppy disc, it means that you have your machine configured to boot on **<Break>** instead of **<Shift><Break>**.

To overcome this problem, type:

***CONFIGURE NOBOOT <Return>**

Followed by a **<Ctrl><Break>**

HARD

HARD DISC

If you get a '**File not found**' error when running from a hard disc, you may have the computer configured with 'No directory' which results in the Library directory not being recognised.

As the boot files are stored in the Library directory you cannot then boot the program - To correct this problem you should type:

***CONFIGURE DIR <Return>**

followed by a **<Ctrl><Break>**.

If you still get the same error you have probably got your machine configured with drive 0 as the default drive instead of the hard disc - which is drive 4. To change this, type:

***CONFIGURE DRIVE 4 <Return>**

followed by a **<Ctrl><Break>**

If your Library directory does not have room for the files RENDER, RENDSET and RENDRESET, you can copy them to any other directory; but you *must* then enter that directory before typing their filenames!



RISC OS

If you have upgraded your machine to the RISC OS operating system, **Render Bender** will still run perfectly well, but note that **Render Bender** will *not* run in the multi-tasking mode.

AUTO-BOOTING

To auto-boot the disc insert your working copy of the System disc in drive 0 and press <Shift><Break>. The program behaves exactly the same as if you were using Arthur 1.2. Auto-booting grabs as much memory as is available for use by **Render Bender**. If you want to use the RISC OS desktop to run **Render Bender** from a floppy insert the System disc in drive 0 and click on the drive 0 icon on the desktop. When the directory viewer opens double click on the '!Render' icon to run the program. When run from the desktop you may need to use the task manager to allocate more memory to **Render Bender**, particularly when using a 440 machine.

INSTALLING ON A HARD DISC UNDER RISC OS

To install **Render Bender** onto a hard disc which is running under RISC OS *do not* use the Install program supplied on the System Disc. Instead, insert the System disc in drive 0, and click on the floppy icon on the desktop to catalogue the disc. Next catalogue the directory on the hard disc where you want to store **Render Bender**. (This is usually the root or '\$' directory - If you place **Render Bender** in the '\$' directory then only the !Render file appears in the '\$' directory so do not worry about cluttering up your root directory with all **Render Bender** files.) Now click on the '!Render' icon in the drive 0 directory viewer and drag it to the destination directory viewer on drive 4. When you release SELECT to drop the icon into the destination directory, the installation is carried out automatically. To run **Render Bender** from the hard disc click on the hard disc icon on the desktop, then double click on the '!Render' icon.

When exiting **Render Bender** under RISC OS you are returned to the Desktop. A hard break is not performed.



GETTING STARTED

The **Render Bender** package contains 2 discs.

The System disc contains all programs, together with sample files. The Resource disc contains additional examples files including picture files that can be used with the **Delta Animator**. (A bonus complete animation called 'Twirl' is also included on the Resource disc. This can be run by loading the animation into the **Delta Animator** as described later). To load files from the Resource disc, insert it in Drive 0 and click on the yellow drive icon.

Render Bender comes in two parts: The Ray Tracing program, and the Animator. The Ray Tracing program is used to create either single pictures or a sequence of pictures and the animator is used to create an animation from a sequence of pictures. When you boot the disc you are presented with the title page and then the selection screen. To skip straight to the selection screen press <Space>. From here you can choose to enter either the Ray Tracing program, **Render Bender**, or the Animation program, **Delta Animator**. To enter the Ray Tracing Program click on the stationary picture, or on the moving picture to enter the Animator. You can also move from one program to the other if you wish.

The text editor in **Render Bender** enables you to include variables into the scene definition so that you can create a series of pictures automatically. The only time you will be directly involved in the process is to insert a new blank disc, if it is required. It is a good idea to have at least 5 blank formatted discs available before using **Render Bender** in earnest. If you forget to format the discs don't worry, **Render Bender** will do it for you.

NOTE:

The ADFS recognises discs using their disc name. If you have more than one disc with the same name this confuses ADFS and may lock up the program. The golden rule is to *always* name your discs individually and never use a backup of the program disc for storing your work on. In the case of **Render Bender** this means you should *never* name your work discs as 'RENDER'. A good convention to adopt is to name your discs 'RENDER1', 'RENDER2', etc and then label them with the same name. Then when ADFS requests a named disc the name should match the label.



The process of creating an animated sequence is:

- Write your text file describing the scene. This uses the keywords understood by **Render Bender**.
- Compile the scene into the internal **Render Bender** format. This file is then used to Ray Trace one or more pictures.
- Ray Trace the required number of pictures.
- Using **Delta Animator** compile the sequence of pictures into the animated sequence. This also contains the code required to run the animation.

Render Bender- THE RAY TRACING PROGRAM

To enter the Ray Tracing section of the package, click on the stationary top picture from the selection screen by moving the cursor to it and pressing the left mouse button (SELECT). When the program has loaded you are presented with the **Render Bender** main menu:

Render Bender					
EDIT SCENE		ANIMATOR		QUIT	
RAY TRACE SCENE	SCENE: BLANK	SAVE	LOAD		
PICTURE SIZE 1/4	LOW RESOLUTION	★ PROMPT WINDOW			
SELECT FLOOR	FLOOR SCALE 100	LOAD PICTURE			
SKY COLOUR PURPLE	SKY DEPTH 600	CONVERT TO SCREENSAVE			
MATT GROUND	SHADOWS	SCREEN DISPLAY ON			
OPAQUE DENSITY 1000	OPAQUE R. INDEX 1.5	NOT SAVING PICTURES			
LENS 400	LAMP AVERAGE 1	FIRST 1	LAST 1		



This consists of a series of icons arranged in groups according to function. The two red icons to the right are titled 'ANIMATOR' and 'QUIT'. If you click on 'ANIMATOR' with SELECT you are asked if you want to move to the animation program. If you click on 'YES' the **Delta Animator** is loaded but if you click on 'NO' you stay in **Render Bender**. A similar sequence occurs if you click on 'QUIT' and you are asked if you wish to leave the program. Click on 'YES' to exit the program or 'NO' to remain in **Render Bender**. If the program is run from the RISC OS desktop you are returned to the desktop when you click on the QUIT icon.

For the moment we will skip the logical order of instructing you in the use of the icons, so that you can see something happening immediately with your program.

LOAD PICTURE

LOAD PICTURE

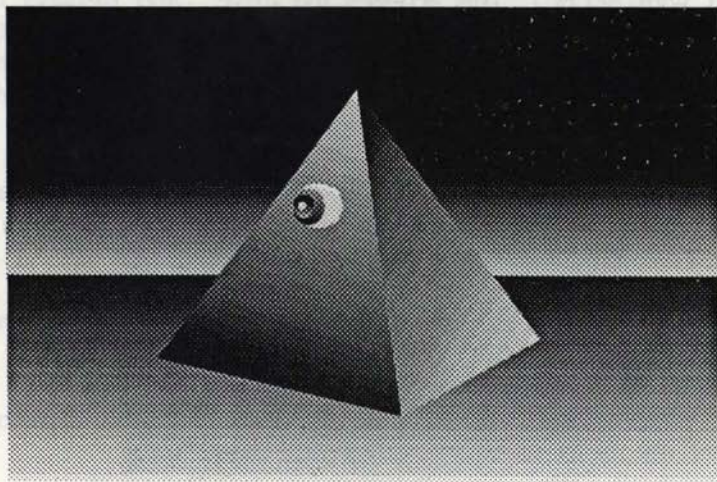
Move the pointer onto the 'LOAD PICTURE' icon in the right hand column and press SELECT. A disc filing window pops up to the right of the screen:





At the top of the large panel the words 'Picture data files...LOAD' indicate that you can load a picture from this menu.

Also in the large panel, the picture files stored on the disc are listed. To load any of these pictures, click on the filename you want with SELECT. The relevant picture is then loaded and shown on screen. A flashing message shown in the bottom left of the screen reminds you that pressing the mouse button will return you to the menu.



'EyePyram1'



Above the large panel are four small icons, one for each drive.

If the configurations indicate that a drive is present, the relevant icon has the words shown in a bright yellow. If a drive is not present, the words are in a 'muddy' yellow.

Drive 0

You will always have at least 'Drive 0' showing in bright yellow and if you have a second floppy, or a hard disc, then the relevant icon will also be shown in bright yellow.

To catalogue any of the drives shown in bright yellow, click on the icon with **SELECT**. This accesses the drive, and displays the catalogue. If you want to catalogue a new disc in drive 0, insert the disc and click on the 'Drive 0' icon (this also applies for other drives). To cancel the filing window, press a mouse button with the pointer *outside* the filing window.

If you click on a disc that does not contain a **Render Bender** 'PICTURES' directory, an error window pops up informing you of this. To continue, press any mouse button.

You cannot load or save files unless they are stored in the correct directory as expected by **Render Bender**.

All pictures and Animations are stored in the directory **!RENDER.PICTURES**.

All scene files are stored in the directory **!RENDER.SCENES**.

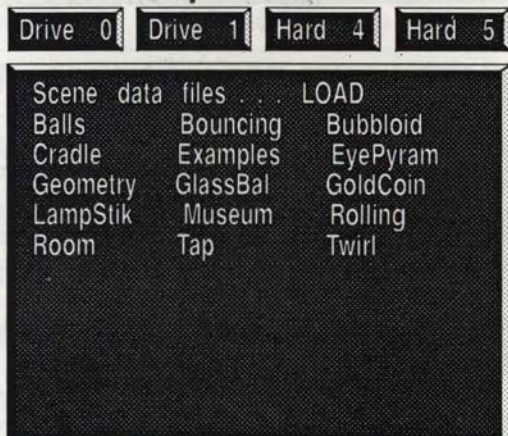
The disc filing system used throughout this package is based upon these principles explained above.

THE EDITOR

The main area in **Render Bender** is the editor. It is here that you define the picture that you want created. Before entering the editor you should load one of the example files supplied on the disc.

LOAD A SCENE

To load a scene click on the yellow 'LOAD' icon at the top of the right hand column. The filing window opens again:

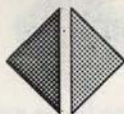


This time you will notice that the top of the large panel says: **Scene data files...LOAD** - indicating that you can load a scene file by clicking on the required filename.

To cancel the filing window press a mouse button with the pointer outside the filing window.

Insert the working copy of your system disc in drive 0, and click on the 'LOAD' icon in the right hand column.

Now click on the file 'Geometry' to load the scene into the editor.



EDIT SCENE

ENTERING THE EDITOR

To enter the editor section of **Render Bender** click on the 'EDIT SCENE' icon in the top left corner of the main menu screen. The editor consists of a large text panel and a number of icons arranged across the top of the panel:



The text panel should contain the 'Geometry' scene. The first line should read:

```
/ Geometric shapes on floor... use floor boards
```

The backslash character '/' is like a REM statement in BASIC, and indicates that the line is not part of the scene but is just for reference.

To enter the text editor move the green mouse pointer into the text panel and press SELECT.

The cursor, a red block, appears at the pointer position. You can move the cursor around using the cursor keys or the mouse pointer. Options available on the cursor keys are listed opposite.

To move the cursor with the mouse, position the pointer where you want the cursor to be moved to and press SELECT on the mouse.

MOUSE

To move the text cursor to another point in the text click on the required position with SELECT; the text cursor immediately moves to the new position.

To scroll the text file up one page click on the top line which says 'Scene editor'. To scroll the text file down one page click on the background below the text area.



KEY CONTROLS

The following keys have these effects when used in the editor:

CURSOR UP	Moves cursor upwards
CURSOR DOWN	Moves cursor down
CURSOR LEFT	Moves cursor left
CURSOR RIGHT	Moves cursor right
SHIFT CURSOR UP	Moves cursor up one page (16 lines)
SHIFT CURSOR DOWN	Moves cursor down one page (16 ")
SHIFT CURSOR LEFT	Moves cursor to start of line
SHIFT CURSOR RIGHT	Moves cursor to end of line
CTRL CURSOR UP	Moves to top of text file
CTRL CURSOR DOWN	Moves to bottom of text file
INSERT KEY	Toggles between insert and overwrite mode
PRINT KEY	Prints a copy of the scene file
COPY KEY	Marks the line containing the cursor
HOME KEY	Copies the marked line to the new cursor position
DELETE KEY	Deletes the character to the left of the cursor



THE EDITOR ICONS

The icons positioned along the top of the text panel perform various functions and they are explained from left to right.

GO
BACK

GO BACK

Click on this icon to return to the main **Render Bender** menu.

COMPILE SCENE

COMPILE SCENE

This compiles the text file into the **Render Bender** internal format which provides the relevant information for Ray Tracing the picture. If variables have been incorporated into the scene these are also compiled so a series of pictures can be created. If an error occurs the editor is re-entered with the error line at the cursor position.

LIST OBJECTS

LIST OBJECTS

Click on this icon to reveal the basic building blocks allowed in **Render Bender**. These include such things as pyramid, box, cone, tube and disc. (*See opposite.*)

CLEAR TEXT

CLEAR TEXT

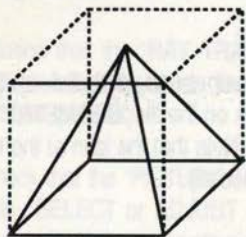
Click on this icon to clear the text panel of any text.

INSERT MODE

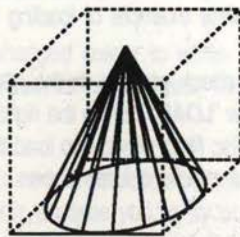
INSERT/OVERLAY MODE

Clicking on this icon toggles between insert and overwrite mode in the editor. When in **INSERT** mode, typing a character causes it to appear at the cursor position, and any character under the cursor is moved to the right. In **OVERLAY** mode, the character that you type overwrites anything under the cursor.

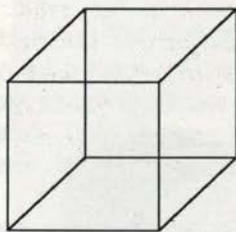
'LIST OBJECTS'



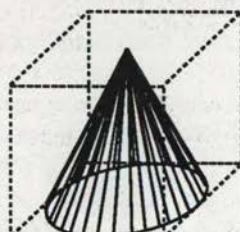
Pyramid



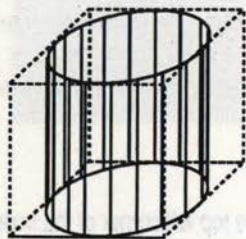
Cone 20



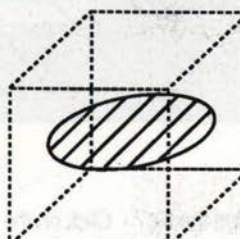
Box



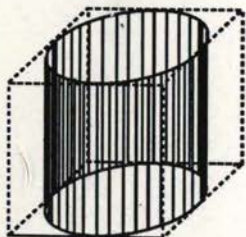
Cone 10



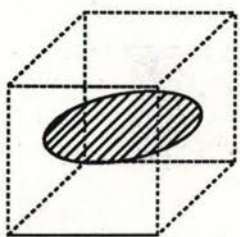
Tube 20



Disc 20



Tube 10



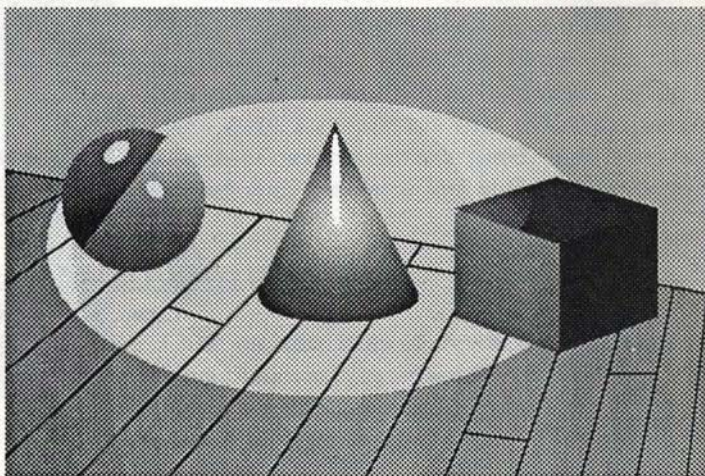
Disc 10



EXAMPLE 1

PLEASE NOTE: You are strongly advised to follow this, and later Examples so that you may quickly familiarise yourself with the software - So let's run through a complete example of loading and compiling a scene.

First check you are in the **Render Bender** main menu, and click on the yellow '**LOAD**' icon in the right hand column. Now click on the file '**GEOMETRY**' in the disc filing window to load the scene into the editor (Note that the icon at the top of the middle column shows the scene that is now loaded).



Loaded the file? - Click on the '**EDIT SCENE**' icon in the top left corner of the screen - you are now in the editor, but don't alter any of the text in the text panel!



Click on the '**COMPILE SCENE**' icon. (An indication of the compilation's progress is shown in the icon box as a percentage) - If you get an error message during compilation, see APPENDIX II for the possible cause. When compilation is completed, click on the '**GO BACK**' icon to return to the menu.

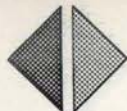
(Notice that the '**RAY TRACE SCENE**' icon has changed colour to white - this indicates that the scene has been compiled, and is ready to create your first Ray Traced picture!)

Check that the '**PICTURE SIZE**' icon is showing 1/16 - If it is not, click on this icon with **SELECT** or **ADJUST** until 1/16 is showing (This enables you to try out the picture in 1/16 size to check the results before committing yourself to a full screen picture which takes much longer to create).

Click on the '**RAY TRACE SCENE**' icon and watch the picture being drawn (You can quit a tracing operation at any stage by pressing a mouse button - The first press stops and indicates time taken, while a second press returns you to the menu) - Once you have traced the picture at 1/16 size try it at 1/4 and whole screen sizes so that you can see the difference in time taken.

There are other options, which either slow down, or speed up the process, and it is advisable to use the quickest method to 'proof' a picture (or sequence) before creating the pictures at full size - You can create a sequence at smaller sizes and still animate them using **Delta Animator**.

The syntax of the scene description language is given in APPENDIX I.



Use this page for your own notes.

THE MAIN MENU ICONS

In the main menu there are lots of different icons grouped together by function. The following pages detail the function of these icons. The explanations are given in some logical order but this may not follow the order on the screen.

RAY TRACE

This icon has already been dealt with and it only functions when the lettering is white. Clicking on this icon Ray Traces a scene taking account of settings in the main menu.



RAY TRACE
SCENE

SCENE

This icon gives the title of the currently loaded scene file. If you have not loaded a scene or have modified an existing scene you will need to give the scene a name. To do this click on the icon, type in the name and press <Return>. Now when you click on the SAVE icon detailed below, the scene will be saved using the name in the box. Names can only be 8 characters long and should end with a number.



SCENE:
BLANK

SAVE

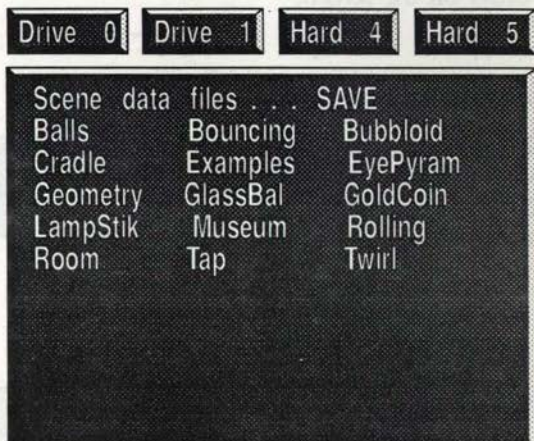
This icon refers to scene files and is used to save scene files to disc. To save a scene enter the name of the scene in the 'SCENE' icon, the one to the left of the 'SAVE' icon, and press <Return>. This provides the filename to be used when saving the scene.



SAVE



When you click on the 'SAVE' icon, the filing window appears with the current catalogue displayed. (If you want to change disc, or catalogue a different drive, you should insert your disc, and click on the relevant drive icon.)



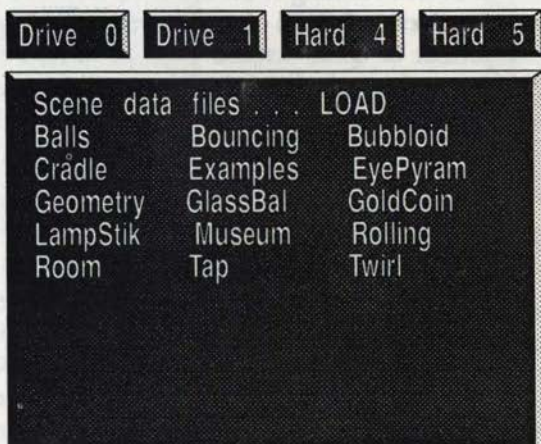
At the top of the filenames panel is the line: **Scene data files...SAVE** indicating that you are about to save a file to disc.

To initiate the save, click on the 'SAVE' icon again. The scene file is then saved using the supplied filename (If a file of that name already exists you are asked if you want to save - by overwriting the existing file - *Be Careful! If you answer 'YES', any data you may wish to keep will be lost*).

If you try to save a scene file onto a blank disc an error is generated which reports that the disc does not have a 'SCENES' directory. A further window asks if you want to create a 'SCENES' directory and if you click on 'YES' the directory is created for you. You can then proceed as detailed above. (If the disc is unformatted a prompt asks if you wish to format the disc).

LOAD

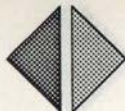
The 'LOAD' icon is next to the 'SAVE' icon in the right hand column. Click on this icon to load a scene file into the editor. When you click on the 'LOAD' icon the filing window appears:



At the top of the filenames panel is the line: **Scene data files...LOAD** indicating that you are about to load a file. To initiate the load click on the filename of the scene that you wish to load.

If you want to change disc or catalogue a different drive you should insert the disc and click on the relevant drive icon.

If you try to load from a disc that does not contain a 'SCENES' directory an error message will appear. You should then insert the correct disc and click on the 'LOAD' icon again.

**PICTURE SIZE**

1 / 4

PICTURE SIZE

This icon allows you to choose the size of the resulting Ray Traced picture. You may want to run the Ray Tracing on a 1/16 screen to see what it looks like before running it on a full screen. The range of sizes is from whole screen to 1/1024 of a screen. Surprisingly you can see the general format of some screens even at 1/1024 size (The smaller screen options are included so that you can do very rapid proofing if the picture is clear enough to allow these sizes to be used).

**LOW
RESOLUTION****RESOLUTION**

This icon enables you to select either HIGH or LOW resolution for your picture. HIGH resolution uses Mode 15 which is 640 x 256 pixels in 256 colours. LOW resolution uses Mode 13 which is 320 x 256 pixels in 256 colours. HIGH resolution, of course, takes longer but the screens are compatible with our own sophisticated ProArtisan software if saved using the 'CONVERT TO SCREENSAVE' option. Use LOW resolution when 'proofing' pictures, and switch to HIGH resolution only for the final product.

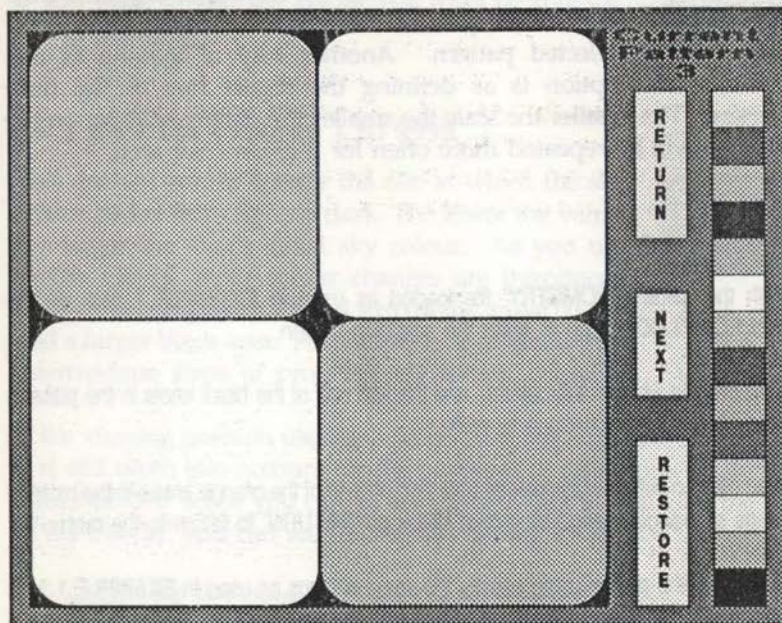
**SELECT
FLOOR****SELECT FLOOR**

This icon enables you to select a floor design and the colours used in that design. To enter the selection screen click on the icon.

The selection screen starts with the current floor pattern and colours. To the right of the pattern area are three vertical icons called 'RETURN', 'NEXT' and 'RESTORE'. RETURN takes you back to the menu, NEXT moves on to the next floor pattern and RESTORE restores the default colours for that floor pattern.



To the right of these icons there is a palette:



You can alter any colour on a floor pattern by **SELECTING** the new colour from the palette, moving the pointer onto the pattern area and then clicking on the colour that you want to change - All areas of that colour in the pattern are changed to the new colour.

Floor patterns and colours are automatically saved with the Scenes file, but you can alter the floor at any time using this option.

If you want the new floor to be the default, and to be stored with the scene, you must re-save the scene file with the new floor set up.



FLOOR SCALE

100

FLOOR SCALE

This icon is used to select the scale used to produce the floor of the picture. The floor is created using your selected pattern. Another way of looking at this option is as defining the repeat rate of the floor pattern. The smaller the scale the smaller the pattern will be, so the pattern will be repeated more often for a given floor area.

EXAMPLE 2

With the same 'GEOMETRY' file loaded as used in **EXAMPLE 1** click on the 'SELECT FLOOR' icon to enter the selection screen.

Now click on white in the palette, and then on one of the black knots in the pattern-Black immediately changes to white.

Next click on yellow in the palette and then on one of the orange areas in the pattern-Areas of orange change to yellow. Click on 'RETURN' to return to the menu.

Ray Trace the picture using exactly the same settings as used in **EXAMPLE 1**. You will now notice that the floor colour shows white and yellow floorboards. Try the same thing again, but this time reduce the Floor Scale value to 50 instead of 100.

Now experiment with various floor patterns and scales.

The floor pattern and scale can be altered at any time so that when you Ray Trace the picture again the new settings are used in the new picture. If you want the new floor to be the default (stored with the scene) you must re-save the scene file with the new floor set-up.

SKY COLOUR PURPLE

SKY COLOUR

This icon enables you to specify the colour of the sky used when Ray Tracing a picture. Each time that you click on this icon it toggles to show a new colour. There are fourteen colours to choose from and after the last colour has been reached you return to the first colour again - Experiment with different colours to see the various effects possible.



The sky colour is also saved with the scene. When you re-load a scene the colour is automatically set to the default you have determined. If you want to alter the colour you must re-save the scene file with the new setting.

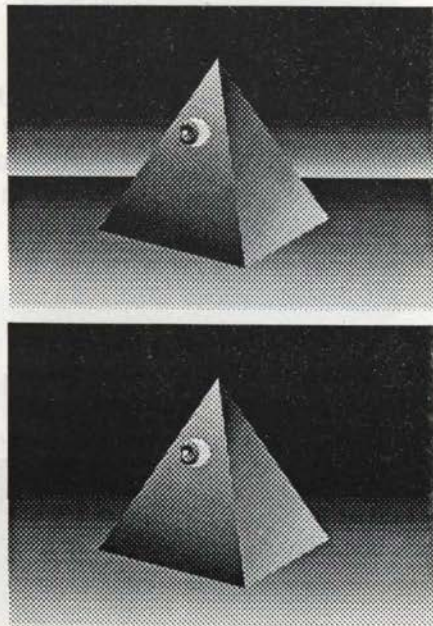
SKY DEPTH - Range 1 to 9999

This enables you to specify the rate at which the sky colour 'fades' from light to dark. The lower the value, the larger the area's initial sky colour. As you use higher values, more colour changes are introduced until you end up with a small strip of the initial colour and a larger black area. All colours fade to black with intermediate steps of progressively darker colours.

SKY DEPTH
600

If the viewing position used in a scene does not make the sky visible it is still taken into account for the purposes of reflections etc. In the 'GEOMETRY' scene you cannot see the sky, but if you load the file 'EYEPYRAM' you can see the red sky fading to black.

Try setting the sky depth to 1 and notice the difference:





MATT GROUND

GROUND

This toggles between SHINY GROUND and MATT GROUND. To toggle the setting click on the icon with SELECT. The effect of this option is quite subtle.

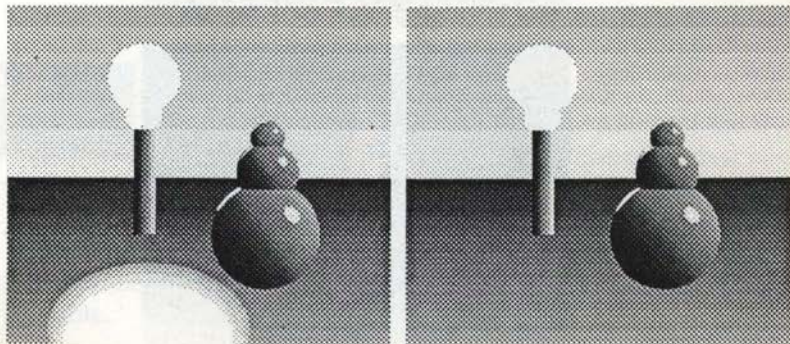
If you have a light source shining onto a MATT ground, the amount of light reflected from the ground is virtually nil. However, if you choose SHINY GROUND then much more light is reflected resulting in the light source being visible on the ground.

The best analogy is to think of a spotlight in a room shining onto a polished floor. In this case the light is visible on the floor but if you were to place a rug or mat on the floor you can no longer see the light reflected. So you can think of the SHINY ground as a polished wooden floor and the MATT ground as a carpeted floor.

Do not confuse 'SHINY' with 'MIRROR' which are both used within **Render Bender**. Mirror surfaces will show reflections of objects around them whilst shiny objects will only reflect light. This gives highlights to a scene and makes it more realistic.

EXAMPLE 3

To show the difference between SHINY and MATT ground we have prepared a special scene called 'LAMPSTIK' which you should load as described earlier. Compile the scene and ray trace the image. Now toggle the 'GROUND' icon from shiny to matt and note the difference. There is no reflection on the floor from the bulb.

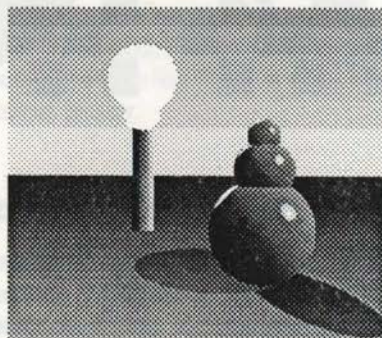
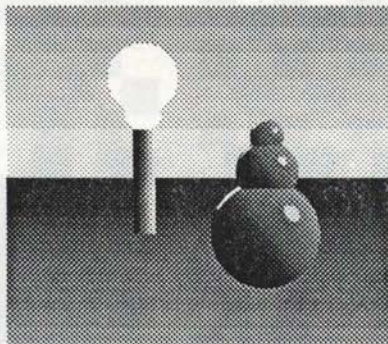




SHADOWS

This icon enables you to specify whether you want shadows to be included in a scene or not. Clicking on the icon toggles between shadows ON and shadows OFF. If you have shadows OFF, the picture is traced faster and we recommend that you have shadows OFF when proofing a picture and only set shadows ON when you are ready to do your final pictures.

SHADOWS



OPAQUE DENSITY - Range 1 to 99999

This icon enables you to specify the degree to which opaque objects transmit light. Although the term 'opaque' is used, a setting of one results in the objects being almost completely transparent. The higher the opaque density, the less light the objects allow to pass through them.

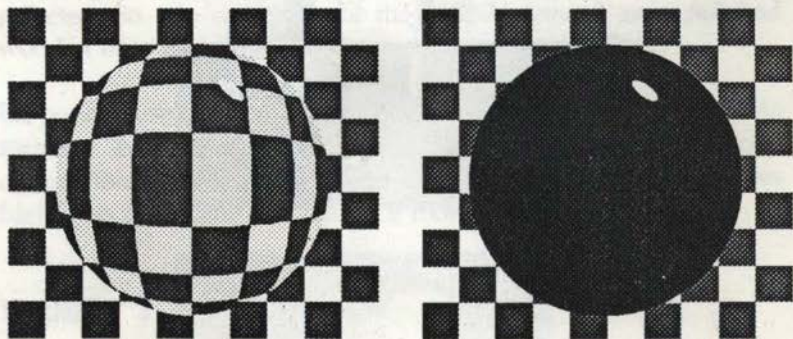
OPAQUE DENSITY
1000



EXAMPLE 4

Load the scene called 'GLASSBAL' that is supplied on the system disc and compile the scene by entering the editor and clicking on the 'COMPILE' icon. If you now Ray Trace the picture with the default opaque density setting of 1200 you can see that the glass ball is slightly opaque.

Now try the same thing with settings of 1 and 99999. You should see that 1 results in the ball being almost transparent whilst 99999 results in it being totally opaque. You will not notice any difference in the results with settings below 200 as it would require glass several miles thick before any noticeable changes take effect.



OPAQUE R. INDEX
1.5

OPAQUE R. INDEX - Range 0.01 to 3

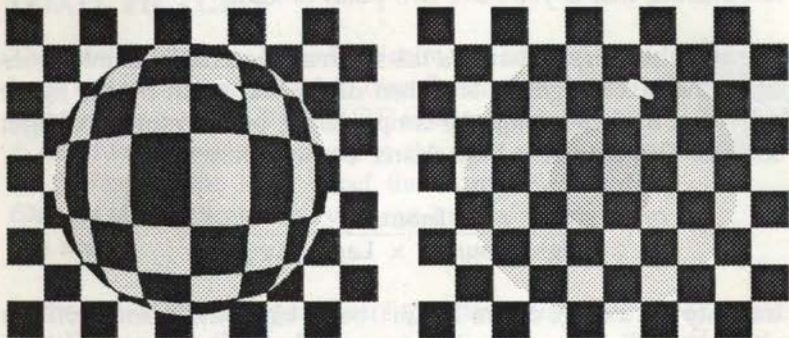
This icon is an abbreviation for OPAQUE REFRACTIVE INDEX. It enables you to alter the refractive index of opaque objects.

The refractive index indicates how the light will be refracted or 'bent' as it passes through the object. A refractive index of 1 results in light passing straight through without any deviation. Glass has a refractive index of 1.5.



EXAMPLE 5

Load the scene called 'GLASSBAL' and compile the scene by entering the editor and clicking on the 'COMPILE' icon. If you now Ray Trace the picture with the default refractive index of 1.5 you can see that the floor behind the ball is distorted. If you now alter the refractive index to 1 and Ray Trace the picture again you will see that there is no distortion.



Values for the refractive index that are less than 1 result in the light being reflected inwards towards the centre of the object. For example try setting the refractive index to 0.5 and you will notice that when you Ray Trace the scene the floor pattern behind the ball apparently becomes smaller.

LENS - Range 100 to 9999

This icon enables you to change the focal length of the imaginary lens used to view the scene. It is like changing from a wide angle lens to a telephoto lens.

LENS
350

When you click on the icon the current value is deleted and you can then enter a new value ranging from 100 to 9999, only whole numbers are allowed. The larger the lens the closer to the scene you appear. Use of the lens means that you can define a scene and then zoom into a small part of that scene whilst still retaining all of the reflections and refractions from the whole scene.



LAMP AVERAGE

1

LAMP AVERAGE - Range 0.01 to 3

This is only of use when you are using more than one light source in a scene. If the explanation below confuses you, don't worry, just leave the setting at 1.

What the lamp average does is to bias the exposure. This is useful if for example you have a scene with two spotlights whose beams do not interact, that is you have two pools of light.

The way the program handles this internally is to add the intensities of all the pixels together and then divide the result by the figure arrived at by multiplying the lamp average by the number of light sources. This may be a little clearer from the formula:

$$\frac{\text{Intensity}}{(\text{Light_Sources} \times \text{Lamp_Average})}$$

Intensity has a range of 0 to 1 with 0 being black and 1 being brilliant white. Therefore to make as much use of the colours as possible you should always try and get the equation to give a value of 1.

With a setting of 2 light sources and a value of one for the LAMP AVERAGE the maximum intensity of each lamp is:

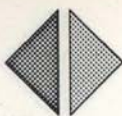
$$\frac{1}{(2 \times 1)} \quad \text{which is } 0.5$$

Setting the 'LAMP AVERAGE' to 0.5 in the formula results in:

$$\frac{1}{(2 \times 0.5)} \quad \text{which is } 1.0$$

A result of 1 means that the picture takes full advantage of the colours available.

We now move on to the right hand column of icons. SAVE and LOAD have already been covered at the beginning of this chapter.



* PROMPT

Clicking on this icon opens up a large panel to the right of the screen with a '*' prompt. From here you can carry out any OSLI or star commands. To remove the panel press <Return> when the '*' prompt is waiting for an input.

*PROMPT
WINDOW

LOAD PICTURE

This icon enables you to load a picture that has previously been ray traced and saved to disc. To do this move the pointer onto the 'LOAD PICTURE' icon and press SELECT. A disc filing window pops up to the right of the screen. At the top of the large panel the words **Picture data files...LOAD** indicate that you can load a picture from this menu.

LOAD
PICTURE

In the rest of the large panel are listed the picture files stored on the disc. Picture files always have a number on the end. Files without a number are usually Animation files and cannot be loaded from here. To load any of these pictures click on the filename with SELECT. The relevant picture is then loaded and shown on screen. A flashing message is shown in the bottom left of the screen reminding you that pressing the mouse button will return you to the menu.

Above the large panel are four small icons, one for each drive. If the configurations indicate that a drive is present the relevant icon has the words shown in a bright yellow. If a drive is not present the words are in a muddy yellow. You will always have at least 'Drive 0' showing in bright yellow and if you have a second floppy or a hard disc then the relevant icon should also be in bright yellow.

To catalogue any of the drives shown in bright yellow click on the icon with SELECT. To cancel the filing window press a mouse button with the pointer outside the filing window.

If you click on a disc that does not contain a **Render Bender** 'PICTURES' directory an error window pops up informing you of this fact. To continue press any mouse button.



CONVERT TO SCREENSAVE

CONVERT TO SCREENSAVE

Render Bender stores its pictures in a special compacted form. If you want to convert a screen into a standard screen for use in other programs such as **ProArtisan** you should click on this icon.

A catalogue of the current drive is displayed and you can then select the picture to be converted by clicking on the filename. If you want to load a file from another disc click on the relevant yellow drive icon first and then click on the required filename. You are next asked for a pathname for the 'SCREENSAVE'd picture. If you wish to save it to another drive you must enter the full pathname including the drive number e.g.

`:1.SCREENS <Return>`

will save the picture to drive 1 in directory SCREENS.

If you only have drive 0 and you want to save on another disc in drive 0 you should enter:

`:0.SCREENS <Return>`

You are then prompted to insert the destination disc and press `<Space>`. In all cases the destination directory must already exist. If it does not you can create the directory using the `*PROMPT` option.

NOTE: If you want to save a screen in the same directory as the Ray Traced pictures, you should enter something like:

`:0.!RENDER.PICTURES <Return>`

or for short:

`:0.!R*.P* <Return>`

When you include the drive identity `:0` in the pathname the program expects you to insert another disc, so prompts you to insert a destination disc and press `<Space>`. If you want to store the screen on the same disc as the source picture just press `<Return>` instead of giving a pathname. This overwrites the compacted picture with an ordinary screensaved version using the same name. All files except Boot files are stored in directory `!RENDER` or directories below it.



SCREEN ON

This icon controls whether the screen shows the picture or not when it is being Ray Traced and saved to disc. If you have the screen off it speeds up the tracing process. To toggle the screen off click on the icon with SELECT.

SCREEN
DISPLAY ON

If you are not saving pictures to disc this icon automatically reverts to SCREEN ON when you start Ray Tracing.

NOT SAVING PICTURES

This icon toggles between NOT SAVING and SAVING pictures to disc. If you only want to proof a picture then you do not need to save it to disc. You should only toggle this icon to saving if you are happy with the picture and want to save the results to disc. The saving is done automatically in conjunction with the FIRST and LAST icons described below. If you are saving a single picture FIRST and LAST will both be '1' and the saving process automatically adds a '1' to the end of the Scene name to produce the first picture from the scene description. If the scene name is too long **Render Bender** automatically reduces the length so that it can add two digits to the end as picture numbers. These numbers are used by the **Delta Animator** to identify picture sequences.

NOT SAVING
PICTURES

FIRST/LAST

These two icons are used in conjunction with the above icon when it is set to SAVING PICTURES. Both these icons are initially set to '1' which means that only a single picture is saved to disc when it has been Ray Traced. If you have a scene file containing more than one frame - you can use these icons to set the start and end frame to be saved to disc. When ray tracing a new set of pictures always enter the first and last screen, even if you do not think they will all fit on the disc. If they are not all saved you can then insert a new disc and click 'RAY TRACE SCENE' again. The program automatically alters the value of FIRST to be the next picture in the sequence. You continue this process until you have Ray Traced all of the pictures.

FIRST
1

LAST
1



When you click on the 'RAY TRACE SCENE' icon you are asked for the drive number to save to. Click on the relevant drive icon to mount the disc. If you wish to abort and return to the main menu click on the background.

If a disc does not have a 'PICTURES' directory an error is generated and you are asked if you want to set up a 'RENDERING' directory. If you click on 'YES' all the relevant directories are set up on the disc, including the !RENDER.PICTURES directory. The program will even format your disc if you have forgotten to prepare the disc beforehand.

When you have the relevant directory on a disc the Ray Tracing begins. If you are Ray Tracing one frame, you will be asked to click the mouse when the frame is complete. If you are Ray Tracing a sequence of pictures, each frame in turn will be Ray Traced and saved to disc. When the process is complete, you will be asked to click the mouse and you will then return to the menu.

EXAMPLE 6

Insert the System disc and click on the 'LOAD' icon. When the scenes appear click on the filename 'GOLDCOIN' to load the scene into the editor. Next enter the editor and click on the 'COMPILE SCENE' icon. When the scene has compiled click on the 'GO BACK' icon to return to the main menu.

You can now click on the 'LAST' icon and enter 9 followed by <Return>. This tells the program to Ray Trace pictures 1 to 9. Next click on the 'NOT SAVING PICTURES' icon so that it changes to 'SAVING PICTURES'. You should also set up the following: **LOW RESOLUTION** and **1/16 PICTURE SIZE**.

Now all that remains is to insert a blank disc and click on 'RAY TRACE SCENE'. You are asked to ensure that a 'PICTURES' directory is present and to click on the drive containing the directory. Ray Tracing is then started.

If the disc in the drive does not have the 'PICTURES' directory, which is stored in directory '!RENDER', you are asked if you want to create a 'RENDERING' directory. If you click on 'YES' the directory is automatically created and the Ray Tracing begins. If you are using a hard disc and click on the hard disc drive number the same procedure is followed.



If you have the **'SCREEN ON'** you can see each picture as it is created but if the screen is off the program does not have to support the screen and so releases processing power which speeds up the tracing.

As each screen is created it is saved to disc with a number added to the end of the filename shown in the **'SCENE'** icon. You can of course alter this name before you start Ray Tracing.

When Ray Tracing is finished a message shows you the average time taken for each frame and you are prompted to press a mouse button to return to the main menu.

When you return to the menu click on the **"PROMPT"** icon to pop up the **OSCLI** panel and type **CAT** followed by **<Return>** to show a catalogue of the **'PICTURES'** directory. You should see nine files named **'GoldCoin1'** to **'GoldCoin9'**.

We can now move on to the **Delta Animator** and turn these pictures into an animated sequence but first press **<Return>** to remove the **OSCLI** panel from the screen.

A final point before we move on is that whilst we have asked you to create these pictures at 1/16 screen size for speed there is nothing to stop you re-doing the exercise at full screen size. It will of course take longer but you can leave it running whilst you are doing other things.

To move on to the **Delta Animator** insert the system disc in drive 0 and click on the red **'ANIMATOR'** icon in the top right of the screen. You are asked if you do want to go to the **Delta Animator**. Click on **'YES'**.

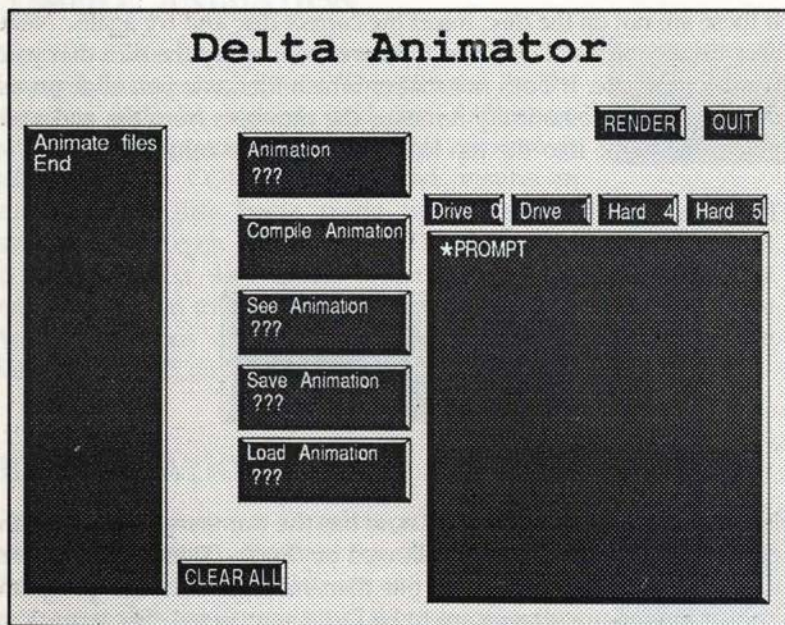


Use this page for your own notes.

THE DELTA ANIMATOR

This section of **Render Bender** enables you to produce animations from pictures produced by the Ray Tracing part of the program or from screens created in Archimedes modes 13 or 15.

On entering the **Animator** you can see that the screen is divided into 3 main areas:



To the left is a column titled ANIMATE FILES, to the right is a combined filing and OSCLI panel, and in the centre the icons controlling creation, viewing and saving of animations.

*PROMPT

To use the *PROMPT panel click on any part of the panel with SELECT and a '*' will appear. You may now enter the required star command and when you press <Return> the command will be executed. To exit, press <Return> without entering a command. You can use this panel to access discs, move or create directories etc.



LOAD PICTURE FILES

Before you can create an animated sequence you must tell the program which pictures you want animating! Insert the disc containing your 'GoldCoin' pictures into drive 0 and click on the yellow 'Drive 0' icon above the filing panel. A catalogue of the 'PICTURES' directory is displayed, and you should have nine 'GoldCoin' files.

If these are not on the disc, insert the correct disc and try again. Next click on any of the 'GoldCoin' filenames to identify the files that you want to animate. It does not matter which filename you click on as the program automatically removes the numbers from the end and places the name into the top icon in the middle column.

This icon should now read:



Note that the left hand column now has the numbers 1 to 9 with an additional 1 listed vertically, followed by 'End' - These numbers are automatically extracted from the filenames so that the program knows how many screens are to be Delta compacted. The extra 1 at the end is to enable the whole animation to loop back to the start.

Clicking on the list of numbers enables you to edit that list - Move up and down using the cursor keys, or by pointing at the required position and pressing SELECT on the mouse. You can then use INSERT and DELETE to insert or remove frame numbers. The main use of this is for removing the '1' at the end so that additional frames can be added from another picture disc (details of use with multiple discs are mentioned later).

In most cases you probably will not need to use this feature, and certainly not with our 'GoldCoin' example!



CLEAR ALL

This icon is at the foot of the left hand column and clicking on it clears the numbers from the left hand column and erases any current animation. Immediately above this icon, the number of frames in the current animation is indicated.

COMPILE ANIMATION

When the number list is correct, click on the 'Compile Animation' icon. The pictures in the sequence will be loaded, and the differences between each picture recorded. This process is called DELTA COMPACTION and results in much smaller files being made up, instead of having to store each frame in turn. This process is quite interesting to watch, and is very quick. When the compilation is complete you are returned to the menu where the 'See Animation' and 'Save Animation' icons are now shown in white, together with the filename 'GoldCoin'.

SEE ANIMATION

Once the compilation is complete, you can see the resulting animation sequence by clicking on the 'See Animation' icon. The screen clears and a message is shown informing you that you can adjust the speed of the animation by using the 'SELECT' and 'ADJUST' keys on the mouse - Press any mouse button to view the animation. To return to the main menu press the centre mouse button.



Save Animation
???

SAVE ANIMATION

Animations are always saved in the 'PICTURES' directory. You can save the animation to the current drive by clicking on the 'Save Animation' icon. The current drive and directory is usually the same directory in which the pictures are stored, unless you change the disc. If you do change discs, remember to click on the relevant yellow drive icon to access the selected disc.

To initiate the save, click on the 'Save Animation' icon again. The animation is saved under the name shown in the 'Animation' title box at the top of the centre column. You will not be permitted to alter the name, as having different names for the pictures and animations may become confusing! Scene files on the other hand, may have the same name. This will not cause **Render Bender** any problems since scenes are stored in their own directory.

Whenever possible you should save the animation file in the same 'PICTURES' directory that contains the picture files, because picture 1 is always required to start the animation.

The animation file only contains the changes from the first picture, so you must always have the first picture for it to work from. If you cannot save the animation file on the same disc you must copy picture 1 into the PICTURES directory on the disc containing the animation, for example:

```
*COPY :0.!R*.P*.PIC1 :0.!R*.P*.PIC1 QPC <Return>
```

will copy the file 'PIC1' from one disc to another on drive 0.

NOTE:

Due to the length of time taken to generate the pictures, it is a sensible precaution to save at least two copies of your animated sequences if you are going to delete the pictures. Once an animation has been created and saved you can delete your picture files, except 'Picture1' of course. This will enable you to reuse your discs for other pictures. If you have enough discs you can keep your original picture files but are only likely to need them again if you lose or corrupt your animation file.



LOAD ANIMATION

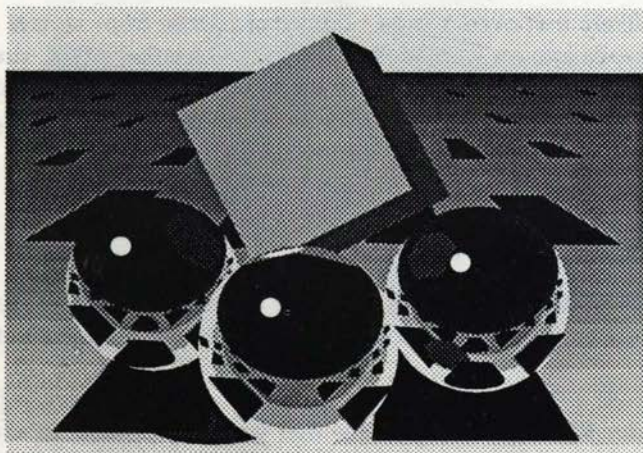
You can also load existing animations from a disc by clicking on the 'Load Animation' icon at the bottom of the centre column. Animations are stored in the 'Pictures' directory, and you can identify them easily (because animation files do not have a number at the end whereas picture files do). If you wish to load an animation from a different drive click on the yellow drive icon and then the required filename. The initial screen relating to any animation file *must* be present when loading an animation file, or the animation will not run.



Load Animation
???

EXAMPLE 7

The **Render Bender** resource disc contains a sample animation file called 'Twirl'. Insert the resource disc in drive 0 and click on the 'Load Animation' icon. The filing window now appears showing the picture and animation files. Click on the file 'Twirl' to load the animation. Now click on 'See Animation' to see it in action.





USE WITH MULTIPLE DISCS

If you have a sequence of pictures which occupy more than one floppy, you can still animate them - Load the pictures from the first disc, edit the list to remove frame one from the end, and then compile the animation.

After the first disc has finished compilation you should insert the second disc, click on the relevant drive icon, and load the pictures from this. Frame 1 will not be included in this list so you can click on 'Compile Animation' straight away. Repeat this sequence for the required number of discs. Finally reload the pictures from the first disc and edit the list so that only Frame 1 is showing (in the left hand column). Now compile this frame onto the end of the sequence. The program adds each successive compilation onto the end of the existing animation sequence, so building up a complete sequence from all the frames.

The complete animation is now in memory, and can be viewed by clicking on the 'See Animation' icon. As long as the animation sequence is no longer than 800K, it can be saved onto a floppy disc.

It is unlikely that even a large number of frames from several discs will compile into an animation sequence greater than 800K, since as it's name implies, the program uses delta compression techniques which result in very high rates of data compression. Larger animations will require an Archimedes 440.

POSSIBLE ERRORS

If a large number of pictures are to be animated, it is possible that there may be insufficient room in memory to store the animation.

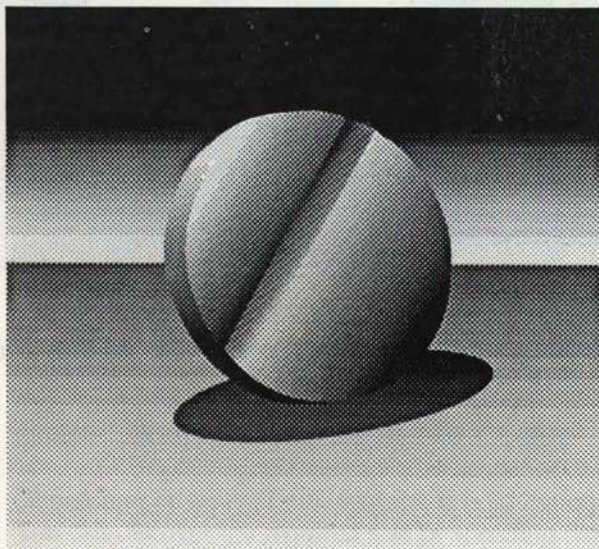
In this case a '**No Room**' error is generated. If the program is being run under RISC OS, it is possible that you may be able to allocate more memory to the program using the Task Manager as described in your RISC OS User Guide.



EXAMPLE 8

Insert the disc containing your 'GoldCoin' pictures into drive 0 and click on the 'Drive 0' icon. The filing panel should show nine 'GoldCoin' files. Click on any one of these files to indicate the filename to the program. The numbers 1 to 9 at the end are placed in the number box on the left of screen.

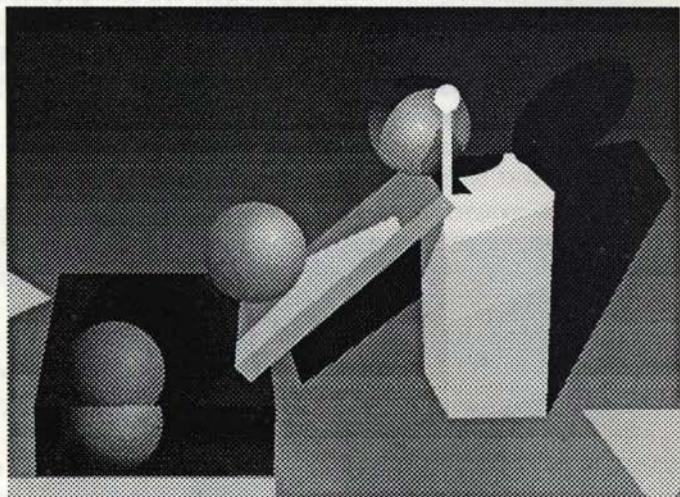
Click on the '**Compile Animation**' icon to compile the pictures and when compilation is complete, click on the '**See Animation**' icon and press a mouse button. You can speed up the sequence by pressing **SELECT** or slow it down with **ADJUST**. Press the centre mouse button to return to the menu and click on the '**Save Animation**' icon to save the animation to your disc.





EXAMPLE 9

To experiment with an animation that uses more than one disc for the picture files use the scenes file '**ROLLING**' supplied on the **Render Bender** system disc and trace the pictures at full size in high resolution mode. This will generate two discs of picture files for you to animate.



See the section 'Use With Multiple Discs' on page 46 for the steps to follow.



LOADING ANIMATIONS INTO YOUR OWN PROGRAMS

Animations can be loaded and run from your own BASIC programs quite easily. The following example program shows how to incorporate the spinning coin animation from the system disc into a simple BASIC program. First enter `*MOUNT 0` <Return> with the system disc in drive 0, then the following:

```

10      *RMLOAD !RENDER.UTILITIES.PICCOMP
20      DIM code &1FA80
30      MODE13
40      OFF
50      OSCLI "LOAD !RENDER.GoldCoin" +STR$ ~code
60      *PICTURE !RENDER.GoldCoin1
70      CALL (code+136)
80      FOR I%=1 TO 100
90      CALL code
100     NEXT

```

Line 10 Loads a module for uncompacting screens saved in the normal **Render Bender** format. It is only needed if the first picture in the sequence is a compressed file. If you use this to create animations to give away to friends, you should use the option to convert the first screen from the sequence into a normal SCREENSAVE'd picture. You can then load the initial screen without having to use the module, which is copyrighted (© 1989 CLARES).

Line 20 Dimensions an array of sufficient size to hold the animation. You can discover the required size by inserting the disc in drive 0 and entering the directory holding the animation file, usually !RENDER.PICTURES. You then type `*EX` <Return> and read off the size as shown in the column second from the right. Remember that these values are in hexadecimal and should be preceded by a '&' when entering the DIM statement.

Line 30 Enters MODE13. If a high resolution animation is involved, MODE 15 should be used instead.



- Line 40** Switches off the flashing cursor.
- Line 50** Loads the animation into the array. The expression `STR$ ~ code` provides the address of the array. The address is assigned by BASIC and the variable 'code' contains that address. The expression used simply converts the address into a string that can be used in the `OSCLI` command. You can use the expressions in lines 20 and 50 in all of your programs and you will only need to change the size of the `DIM` and the filename to be loaded.
- Line 60** Loads the first frame onto the screen using the uncompact routine provided in the `PICCOMP` module. If the first frame has been converted to a normal `SCREENSAVE'd` screen use `*SCREENLOAD` instead.
- Line 70** Initialises the code for running the animation.

Lines 80-100 Display frames which spin the coin about 10 times.

If you want to have the animation displaying continually you can use the following two lines:

```
Line 80 REPEAT
Line 100 UNTIL FALSE
```

The only way to exit this program is to press <Escape>.

NOTE: To initialise any animation file you must use the statement:
`CALL (address + 136)`

where 'address' is the address in memory where the animation file resides. To initiate the animation use:

```
CALL address
```

Each call to 'address' displays one frame so you will need to set up a controlling loop. Within this loop you can add other effects such as mouse control over the speed. You can slow animations down by including a time wasting loop. You can also introduce sound within this loop to add musical effects.



ANIMATING STANDARD SCREENS

It is possible to use **Delta Animator** on ordinary SCREENSAVE'd pictures created with other packages. To do this, screens must be in **MODE 13** or **MODE 15** and be uncompressed - Then you must ensure that the screens provide a smooth animation.

The screens must produce an animated sequence, you cannot simply use it to create a carousel of various pictures.

For example, you could draw a sequence of pictures using **ProArtisan** and then feed them through **Delta Animator** to produce an animated sequence.

If you are using a sequence of screens in this way, they must be named with the frame number following a common stem, for example:

'pic1', 'pic2', 'pic3', 'pic4' etc.

The pictures must be in the directory !RENDER.PICTURES. You can do this by copying the files into the directory or by renaming the files. For example, if you have some **ProArtisan** screens in the directory !PROART on drive 0, you can type:

```
*ACCESS :0:PROART.* WR <Return>
```

```
*CDIR !RENDER <Return>
```

```
*RENAME :0:PROART :0:RENDER.PICTURES <Return>
```



POINTS TO PONDER

Because you can use the **Delta Animator** to animate standard Mode 13 and Mode 15 screens you can use sprites to position items on the screen and save the screen at various stages. Then when you run them through the **Delta Animator** the screens will be compacted into an animated sequence.

You can also take 'High Resolution' Mode 15 screens from **Render Bender** and use them in **ProArtisan**. You do this using the "Convert to Screensave" option.

As well as providing rendered images for use in **ProArtisan** you could use this facility to add some graphics to the **Render Bender** picture using **ProArtisan**. If you have a sequence of pictures for animation you could convert all of these screens to standard screens and add graphics to each screen using **ProArtisan**. Then when you animate the screens the additional elements added by **ProArtisan** will be included in the sequence. The additions will not be part of the rendered scene and so will not affect reflections or shadows but with skillful placing these additions could contribute greatly to an animated sequence.



APPENDIX I

SCENE DESCRIPTION LANGUAGE

IMPORTANT: Remember that you will discover more about how things work if you experiment. Try altering colours, shapes, angles etc., and eventually you will be able to visualise what each of the commands can do. If you try to understand all of the concepts without experimenting you will soon become confused.

The scene description language used in **Render Bender** consists of a series of commands which allow the positioning of objects in three dimensional space. These scenes are defined in the editor within the **Render Bender** part of the package. The explanations are very technical and by far the easiest way to understand them is to 'play' with the settings in one of the scenes provided on the system disc. You can then Ray Trace the picture at a small size to see the different effects.

It is possible to define a scene in such a way that some of the objects or light sources are not visible on screen. This may sound crazy but it means that you could for example define a spotlight shining onto a mirror surface that then reflects that light onto an object on the screen, even though the spotlight and mirrored surface are not visible on screen.

The Resource disc contains a Scenes file called 'Examples' which illustrates some of the commands. The scene is set up initially to illustrate a box, viewing position and the relevant light source. Other lines are REM'd out using the '/' character. To view each object independently you should REM out the current object and remove the '/' from the line containing the object you wish to see. You can then recompile the file, return to the main menu and Ray Trace the picture at 1/16 size.

IMPORTANT! All commands and parameters must have a comma separating them.

Spaces between commands and parameters are ignored so you can leave spaces between groupings of parameters to make reading them easier.



For example:

ROTATE, VX,VY,VZ, X,Y,Z

is the same as, but easier to read than:

ROTATE,VX,VY,VZ,X,Y,Z

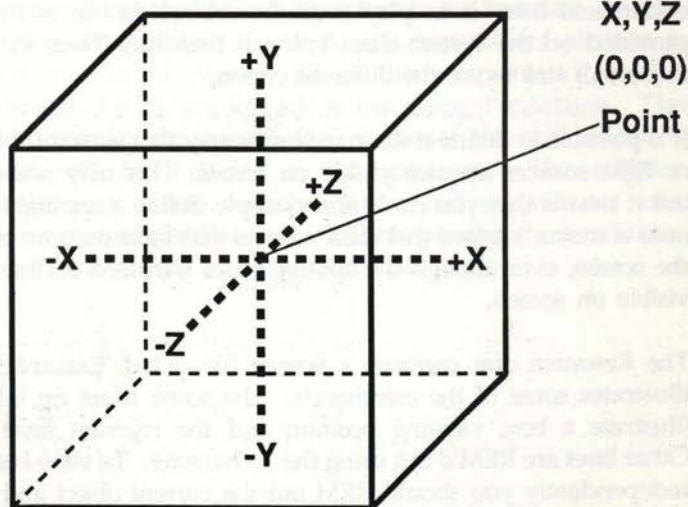
CO-ORDINATES

The co-ordinates used to define objects in 3 dimensional space are:

X incrementing to the right

Y incrementing upwards

Z incrementing into the screen



A value of 0 for X is the centre point of the X or horizontal plane. Negative values are to the left of this point and positive values to the right of it.

A value of 0 for Y is at floor level on the vertical plane. Positive values are above floor level and negative values lower the floor level.

A value of 0 for the Z axis is at the centre of the scene. Positive values advance into the scene and negative ones move back from the centre.



These statements mean that the point 0,0,0 is at the centre of the scene 'world'. If you think of the 'world' as a sphere or cube then point 0,0,0 is at its centre.

NOTE:

It is sometimes easier to place objects around the 0,0,0 point. For example when defining symmetrical objects like 'Bubbloid' you can then use negative co-ordinates to move left on the X axis and to the back on the Z axis. Making Y negative has the effect of lowering the floor which also means that objects float above the floor. See the 'Bubbloid' scene file for examples.

In some cases the co-ordinates also have another letter in front of them to indicate what is being specified. In all cases the commands and specifiers can be in either upper or lower case.

COMMANDS

The commands used by the language are now described:

`VIEW, X,Y,Z, A,B`

or

`VIEW, X,Y,Z, AT, SX,SY,SZ`

The view command specifies the observers eye position. Every scene must have one view command of which there are two forms. In both, the observers X, Y, and Z co-ordinates are specified. This gives the position that you are viewing the scene from.

If you have positioned objects around the 0,0,0 point and you wish to view the object head-on, you should make the viewing position something like:

`VIEW, 0,40,-100, AT, 0,10,0`

This gives a position central on the X plane, 40 units high on the Y plane and 100 units back from the centre of the 'world'. The point you are looking at is at the centre of the 'world' except that it is 10 units up on the 'Y' axis.



Alternatively you can specify the direction you are looking in using A,B instead of the 'AT, SX, SY, SZ' syntax. Where A is the angle of viewing in degrees about the Y axis clockwise, and B is the angle of viewing in degrees about the X axis clockwise. To use the analogy of your head, B defines whether you are looking up, down or straight ahead and A defines whether you are looking left, right or even behind you.

See the scenes file called 'Examples' on the Resource disc and note the VIEW command. Ray Trace this picture at 1/16 screen size and then alter the values for the VIEW command one at a time by doubling the values shown.

LIGHT SOURCES

There can be up to four light sources in a scene and there must always be at least one. A light source can be one of three types:

- 1) **LIGHTBEAM, I, VX,VY,VZ**
BEAMLIGHT, I, VX,VY,VZ

These commands are identical and set up a parallel beam of light just like a ray of light from the sun. I is the intensity from 0 to 1 and is best left at 1 in most cases.

VX, VY, and VZ are the direction vectors indicating the direction in which the light travels. For example, values of 0,-1,0 would indicate light beams coming down vertically.

VX, VY and VZ are inter-related and can be of any magnitude. Therefore 0,-150,0 is the same as 0,-1,0 and 100,-100,0 is equivalent to 1,-1,0. The important thing is the ratio between the values and not their individual magnitude.

See the 'Examples' scene file for an example.



- 2) **LIGHTPOINT, I, X,Y,Z**
 POINTLIGHT, I, X,Y,Z

These commands set up a source of light similar to a light bulb. I is the intensity and X, Y and Z are its position. Try REMing out the LIGHTBEAM command in the 'Examples' file and use just the LIGHTPOINT example.

- 3) **SPOTLIGHT, I, X,Y,Z, VX,VY,VZ, A**
 LIGHTSPOT, I, X,Y,Z, VX,VY,VZ, A

This command sets up a spotlight. It is more complex than the other light sources. I is again the intensity, X, Y and Z are the position of the spotlight, VX, VY and VZ are the direction vectors and A is the aperture. Direction vectors specify the direction in which the light shines and aperture controls the width of the light cone. An aperture can have values from 0 (very wide) to 1 (very narrow).

REM out the other light sources and try using the SPOTLIGHT command in the 'Examples' file. Then alter the Aperture value from 0.88 to 0.80 and recompile the file.

If you want the light source to illuminate an object from your viewing position always ensure that both the viewpoint and light source are on the same side of the object. If they are on different sides the object will be cast in shadow with the light on the surface facing away from you.

EXAMPLE 10

The file 'Geometry' on the system disc uses the SPOTLIGHT command. Compile and Ray Trace the picture as it is, then try altering the first spotlight from .88 to .92. When you Ray Trace the scene again it has a much smaller beam.

Try altering the SPOTLIGHT command to read:

```
SPOTLIGHT, 1,-120, 155, -60, 220, -195, 60, .88
```

You can see that the spotlight is shining in a different direction. Try altering the -195 value by various amounts to familiarise yourself with the concepts. Remember that it is possible to define things in such a way that they do not appear on the screen.



OBJECTS

Objects are the shapes used in defining a scene. The shapes are geometric and you can build up many different pictures using these basic building blocks. The objects can have a number of optional specifiers as listed below, and are identified by a preceding colon. Any number of specifiers can be given in any order.

The object specifiers are:

SPECIFIER	ABBREVIATION
:BLACK	:BLA
:RED	:R
:GREEN	:GR
:YELLOW	:Y
:BLUE	:BLU
:MAGENTA	:MA
:CYAN	:C
:WHITE	:W
:GOLD	:GO
:PINK	:PI
:LIME	:L
:BLUEGREEN or :GREENBLUE	:BLUEG
:SKYBLUE	:SK
:PURPLE	:PU
:SHINY	:SH
:MIRROR	:MI
:OPAQUE or :GLASS	:OP or :GL
:METAL or :METALIC	:ME
:BULB	:BU

All these may be abbreviated as shown.

All the above are self explanatory except for :BULB. What this does is to create an object that is brilliant white no matter what light is falling on it. An example of :BULB can be seen in the scenes file 'LampStik'.

The following details show the syntax used for defining objects followed by an example command for each. The term 'SPEC' can be replaced by any one or more of the specifiers listed earlier:

SPHERE

SPHERE, :SPEC, X,Y,Z, R
 E.G. SPHERE, :MIRROR, 0,60,0, 35

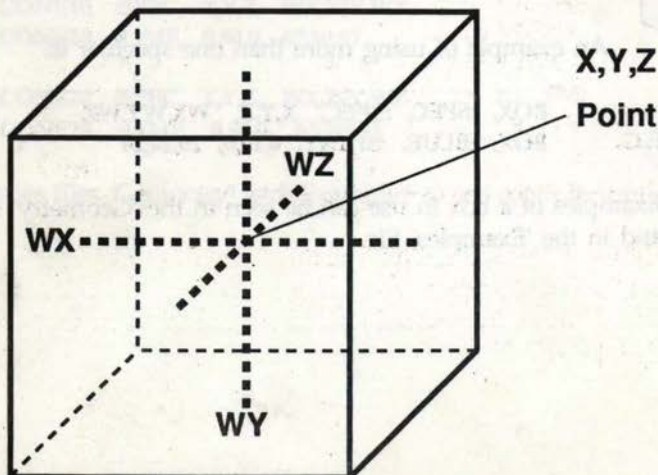
The X,Y and Z co-ordinates of the centre of the sphere are given, followed by its radius. See scene file called 'Examples'.



OTHER OBJECTS

In the following examples the X, Y and Z co-ordinates are followed by WX, WY, WZ, which are the X, Y, and Z scale factors, determining the object's size. The scale factor controls the scale of the object but the size that you see it on screen is also governed by its Z position, the viewpoint and the Zoom lens setting.

The easiest way to imagine the X, Y, Z, co-ordinate is that it defines the centre of a cube, i.e. the point is the same distance from all walls of the cube. This means that the values you give for WX, WY and WZ are half the length of the relevant sides. A cube defined with WX, WY, WZ set at 50, 50, 50 has sides of 100 in all directions.



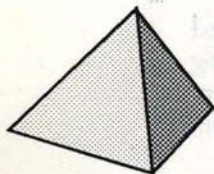


This is clear for a cube but not as apparent for other objects. In the case of a pyramid the base is $(2 \times WX)$ in the X axis, $(2 \times WZ)$ in the Z axis and $(2 \times WY)$ in the perpendicular Y axis.

A cone is best thought of as a pyramid with the corners rounded off.

Tubes are defined as ellipses with WX being the X radius and WZ being the Z radius. If both are defined equal then the tube is circular. WY defines the tube height.

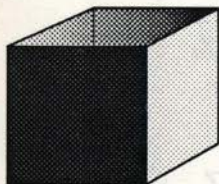
Discs are similar to tubes except that the WY value is irrelevant as discs are always flat.



PYRAMID

PYRAMID, :SPEC, X,Y,Z, WX,WY,WZ
 E.G. **PYRAMID, :GOLD, 0,50,0, 50,50,50**

See the scenes files 'EyePyram' and 'Examples' for examples.



BOX

BOX, :SPEC, X,Y,Z, WX,WY,WZ
 E.G. **BOX, :GREEN, 0,35,0, 35,35,35**

An example of using more than one specifier is:

BOX, :SPEC, :SPEC, X,Y,Z, WX,WY,WZ
 E.G. **BOX, :BLUE, :SHINY, 0,10,0, 20,20,20**

Examples of a box in use can be seen in the 'Geometry' scenes file, and in the 'Examples' file.



DISCS

DISC10, :SPEC, X,Y,Z, WX,WY,WZ
 E.G. DISC10, :METAL, 0,50,0, 50,50,50

DISC20, :SPEC, X,Y,Z, WX,WY,WZ
 E.G. DISC20, :METAL, 0,50,0, 50,50,50

Disc10 uses more faces for the edge of the disc than disc20.

In the 'Examples' file the discs are rotated 90 degrees through the X axis. If you want to rotate an object about its centre point you must ensure that the centre of rotation is the same as the X,Y,Z position of the object.

In some cases you will not be able to see the Disc using the small screen sizes. This will happen if the disc is side on to your view point and the distance from the object results in the disc thickness being less than one pixel. In such cases increase the screen size or alter the angle of the disc.

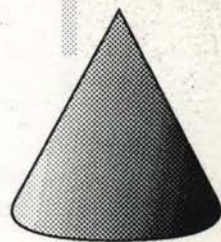
An example of a Disc in use can be seen in the 'GoldCoin' scene file, and in the 'Examples' file.

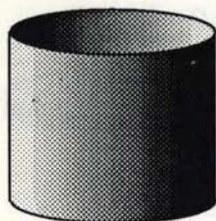
CONES

CONE10, :SPEC, X,Y,Z, WX,WY,WZ
 E.G. CONE10, :LIME, 0,50,0, 67,50,37

CONE20, :SPEC, X,Y,Z, WX,WY,WZ
 E.G. CONE20, :LIME, 0,50,0, 65,50,35

See the scenes files 'Geometry' and 'Examples' to see cones in use.





TUBES

TUBE10, :SPEC, X,Y,Z, WX,WY,WZ
 E.G. TUBE10, :CYAN, 0,52,0, 35,42,40

TUBE20, :SPEC, X,Y,Z, WX,WY,WZ
 E.G. TUBE20, :PINK, 0,53,0, 5,53,20

Examples of a Tube in use can be seen in the scene files 'GoldCoin', 'Examples' and 'Bubbloid'. To provide realistic tracing speeds the program uses 'Back Surface Removal' on tubes. This means that you cannot look through, or see the lip of a tube. If you try to look down a tube the program does not trace it. If we did not use this method the Ray Tracing process would be much longer than it is now.

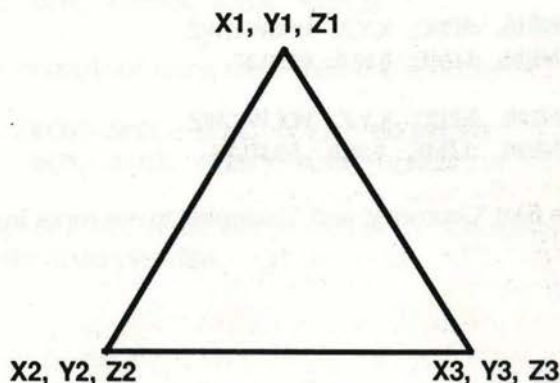
POLYGONS

POLY3, :SPEC, X1,Y1,Z1, X2,Y2,Z2, X3,Y3,Z3

POLY4, :SPEC, X1,Y1,Z1, X2,Y2,Z2, X3,Y3,Z3, X4,Y4,Z4

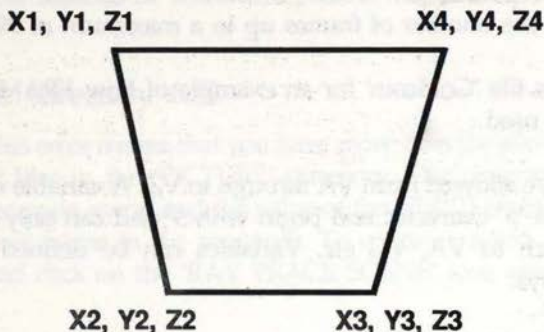
In the case of the polygons each vertex is specified.

POLY3 is best thought of as a Triangle where you specify the X, Y, Z co-ordinates for each of the corners:





POLY4 is a quadrilateral, that is a four-sided polygon. In a quadrilateral the four sides can be of any length. This contrasts with a square in which all sides must be equal and a parallelogram whose opposite sides are equal. You can of course make a quadrilateral into a square or parallelogram by positioning the corners to form these shapes.



See the scenes files 'Geometry' and 'Examples' for examples of POLY3 and POLY4 in use. There are two examples of POLY4 in the 'Examples' scene file.

You cannot view the reverse side of a polygon as this also uses 'Back Surface Removal' to simplify and speed up Ray Tracing.

ROTATE

ROTATE, VX,VY,VZ, X,Y,Z

This allows you to rotate objects about any axis. VX, VY, VZ are the angles of rotation about the X, Y and Z axis. X, Y, Z are the position about which rotation takes place. For example:

```
BOX, :SHINY, :BLUE, 0,10,0, 20,20,20, ROTATE, 0,45,0, 0,10,0
```

This will rotate a box by 45 degrees around the Y axis as shown in the 'Examples' scene file. Note that the X,Y,Z position is the same for the box and the centre of rotation. They do not need to be so, but must be if you want to rotate around an object's centre.

The 'ROTATE' command must have commas before and after it.



ANIMATION

A number of commands are available for producing animated sequences.

FRAMES,n

This specifies the number of frames up to a maximum of 99.

See the scenes file 'Goldcoin' for an example of how FRAMES and variables are used.

26 variables are allowed from VA through to VZ. A variable must be preceded by a '>' character and begin with V and can only be two characters such as VA, VG etc. Variables can be defined in the following ways:

```
>VA=23
>VB=1,2,3,4,5
>VC=1 THRU 10,5
>VD=1,2,0 THRU 0,3,4,5
```

VA is defined as having the constant value 23

VB is defined as having the values 1,2,3,4,5 in successive frames

VC is defined as starting at 1 and incrementing to 10 in five steps

VD is defined as having values 1,2 then 0,0,0 then 4 and 5

The statement THRU is preceded by the start value and followed by the end value. The next number is the number of steps that are used to get from the start number to the end number. The steps do not need to be in whole numbers.

These variables can be used in any of the shape statements. Expression evaluation is also allowed, for example:

```
SPHERE, :SHINY,100,(COS(RADVA)+SIN(RADVB)),100,40
```




APPENDIX II

ERRORS

Most errors that you will get are self explanatory and are handled through a pop-up error window. This window will either disappear after a few seconds or when you press a mouse button.

Current directory full

This error means that you have more than the allowed number of files in the 'PICTURE' directory. The program returns to the main menu and the value of the 'FIRST' frame is set to the next frame in the sequence. To continue insert a blank disc and click on the 'RAY TRACE SCENE' icon again.

Command not permitted

This error can occur when using '*' commands if you try and perform either a QUIT or BASIC. These commands would cause problems if you were to use them.

Disc full

This means there is no room to store any more screens on the disc. The program returns to the main menu and the value of the 'FIRST' frame is set to the next frame in the sequence. To continue insert a blank disc and click on the 'RAY TRACE SCENE' icon again.

Frames out of range

Means that there are more than the allowed 99 frames specified.

Illegal drive

This means you have selected a drive which is not installed in your machine.



Invalid variable

You are trying to specify a variable other than variables VA to VZ, as allowed by the program.

Line too long

This usually means you have too many parameters for a given object. It occurs if, for example, you define a BOX, then change it to a SPHERE but forget to remove the extra parameters.

Line too short

Means that you do not have the required number of parameters for a given statement.

Missing comma on AT

This means you have omitted a comma in a line containing the AT keyword.

Missing comma on ROTATE

This means you have omitted a comma in a line containing the ROTATE keyword.

Missing comma on THRU

This means you have omitted a comma in a line containing the THRU keyword.

Mistake in rotation matrix

If you get this error you should check that your ROTATE command is correct. You may have omitted a parameter.



Mistake in specifications

This refers to :SPEC parameters such as :BLUE, :SHINY etc. and probably means that you have made a typing error or the :SPEC is missing.

Mistake in syntax

Means that you have made an error when entering the text. Check that commas are in the right places.

No lights defined

Means that you have forgotten to define a light source.

No such command

This means that you have entered a command that **Render Bender** does not understand.

No such variable

Means that you are trying to use a variable that has not been predefined.

No viewpoint defined

Means that you have not set up a viewpoint using the VIEW command.

Not a picture file

This means that the selected file is not a picture file.



Not a scene file

This means that the selected file is not a scene file.

Thru out of range

Means that you have more steps in THRU than you have assigned in the FRAMES specification.

Too many illuminations

This error is generated when you have defined more than 4 light sources.

Too many objects defined

This means that the scene is too complex to Ray Trace in the memory available. If you are using RISC OS, you may be able to allocate more memory from the desktop.



INDEX

PAGE

Adjust	3
Animate Files	41
Animating Standard Screens	51
Animation	2, 64
Appendix I	53
Appendix II	65
Auto-Booting	9
Backup Discs	5
Booting	6
Booting Problems	8
Box	19, 60
'Bubbloid'	55, 62
Clear All	43
Clear Text	18
Click On	3
Comma missing	66
Commands	55, 65
Compile Animation	43
Compile Scene	18
Cones	19, 61
Convert To Screensave	36
Co-ordinates	54, 59
Current directory full	65
Delta Animator	41
Delta Compaction	43
Discs	19, 61, 65
Displaying Results	2
Drive Icons	14

A

B

C

D



	INDEX	PAGE
E	Edit Scene	16
	Editor	15
	Editor Icons	18
	Errors	46, 65
	'EyePyram'	13, 29, 60
	Example 1	20
	Example 2	28
	Example 3	30
	Example 4	32
	Example 5	33
	Example 6	38
	Example 7	45
	Example 8	47
F	Example 9	48
	Example 10	57
	'Examples'	56, 59, 60, 61, 62, 63
	Exiting	9
	First	37
	Floor Patterns	26
	Floor Scale	28
	Floppy Disc	8
	Frames	64, 65
	G	'Geometry'
Getting Started		10
'Glassbal'		32, 33
Go Back		18
'GoldCoin'		38, 42, 47, 61, 64
Ground		30
H	Hard Disc	6, 7, 8, 9
	High Resolution	26
I	Illegal drive	65
	Insert Mode	18
	Installing	9
	Introduction	1
	Invalid variable	66



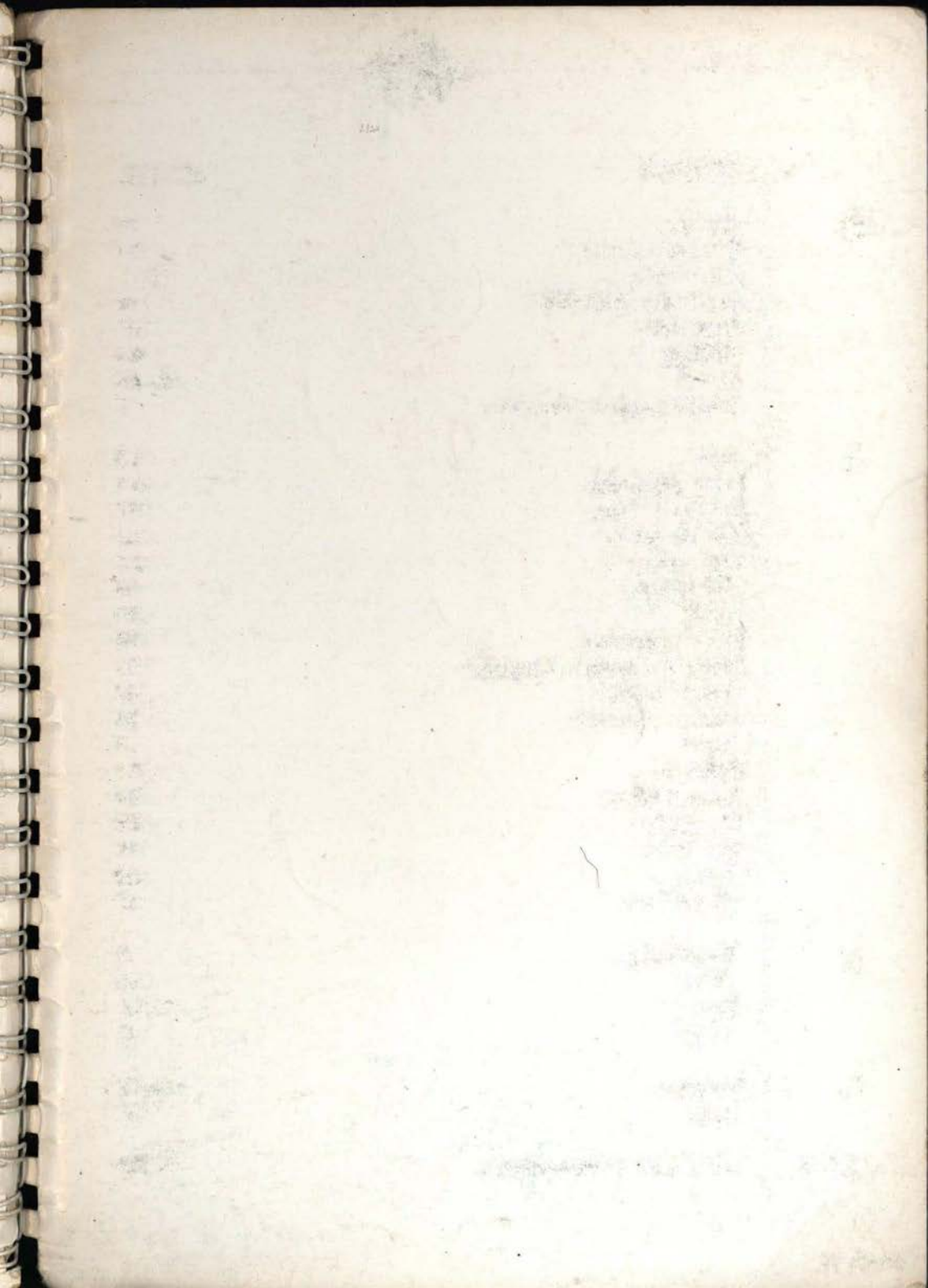
INDEX

PAGE

Key Controls	17	K
Key Words	4	
Last	37	L
Light sources	56	
List Objects	18, 19	
Lamp Average	34	
'Lampstik'	30, 58	
Lens	33	
Line too long/short	66	
Load Animation	45	
Load Picture	12,42	
Load Scene	15, 25	
Loading Animations Into Your Own Programs	49	M
Loading the Program	6	
Load Picture	35	
Low Resolution	26	
Main Menu Icons	23	
Making a backup disc	5	
Matt Ground	30	
Mouse	3, 16	
Multiple Discs	46	
Not Saving Pictures	37	
Objects	58, 68	
Opaque Density	31	O
Opaque R. Index	32	
Overlay Mode	18	P
Overview	1	
Picture Size	26	
Pictures Directory	35, 38, 44	
*Prompt window	35, 41	
Polygons	62	
Possible Errors	46	
Problems when Booting	8	
Pyramid	19, 60	



	INDEX	PAGE
R	RISC OS	9
	Ray Trace Scene	23
	Ray Tracing	1, 11
	Rendering Directory	38
	Resolution	26
	'Rolling'	48
	Rotate	63, 66
	Running from a Hard Disc	7
S	Save	23
	Save Animation	44
	Saving Pictures	37
	See Animation	43
	Select Floor	26
	Scale factors	59
	Scene	23
	Scenes Directory	24
	Scene Description Language	53
	Screen Display	37
	Screens Directory	36
	Select	3
	Shadows	31
	Shiny Ground	30
	Sky Colour	28
	Sky Depth	29
Sphere	59	
Syntax error	67	
T	Terminology	3
	THRU	66
	Tubes	19, 62
	'Twirl'	45
V	Variables	66, 67
	View	55
XYZ	'X', 'Y' and 'Z' co-ordinates	54, 59





CLARES

MICRO SUPPLIES

98 Middlewich Road, Rudheath, Northwich, CHESHIRE CW9 7DA.
Telephone: 0606 48511 Fax No: 0606 48512