**Raytracing**

Raytracing, is used to incorporate two optical effects into a rendering that the default software rendering method can’t handle. *Raytracing* traces rays of light from each light source to every object in the shot and then traces the light’s reflection from the object to the camera’s lens. This

allows true *reflections* and *refractions* to appear in the render as well as highly defined

shadows.

**True Reflections** True reflections occur when every object in the scene is viewed in a

reflective surface, as a reflection, of course. You can also have objects with reflections

explicitly turned off through the Render Stats section in the Attribute Editor in case you

don’t want a particular reflection, which is common. Although it’s possible to simulate

reflections in Maya Software using *reflection maps*, true reflections can be generated

only through raytracing. (In Chapter 7, “Autodesk® Maya® Shading and Texturing,” the

TableLamp project shows how to apply reflection maps.)

**Refractions** *Refractions* occur when light bends as it passes through one medium into

another medium of different density. For example, a pencil in a glass of water appears

to be broken. Refraction can also be turned on or off explicitly through Render Stats for

objects that you don’t want to see refracting through another clear object.

You saw in the previous chapter that raytracing is also a vital component of mental ray

for Maya as well as the Maya Software renderer.

As soon as raytracing is enabled, any reflective surface receives a true reflection of the

objects and environment in the scene. Even objects with reflection maps reflect other

objects in addition to their reflection maps. For more on reflection maps, see the section

“Reflections and Refractions” later in this chapter.

**Raytracing Soft Shadows**

One interesting feature of shadows is that they can diffuse or soften as the shadow falls

farther away from the object casting the shadow. For example, hold a pen on its end on

your desk and notice how the pen’s shadow gets softer or fuzzier the farther it is from

where the pen meets the table. This small detail can greatly enhance the reality of any

render.

**Reflections and Refractions**

As you saw in Chapter 7, creating a “faked” reflection with a map for an object is pretty

simple. To generate true reflections without the use of maps, however, you’ll need to

manually enable raytracing in Maya Software or use mental ray for Maya, which has raytracing

enabled by default.

**Raytraced Reflections**

With raytracing, Rendering Software reflects any objects in the scene that fall in the proper line of sight. All you need to do is use shaders that have reflection attributes such as Phong or Blinn. Note that Lambert shader does not reflect.

One can control the the quality of the render by specifying how many times to reflect

or refract for any given object. Setting Reflections to 2, for example, enables an object’s

reflection in a second object to appear as part of its reflection in a third object.

The first image in Figure 11.12 shows the still life reflecting onto the surface of its table.

In this case, Reflections is set to 1. If you increase Reflections to 2, however, you’ll see the

reflections of the pieces of fruit in each other also reflecting in the surface of the table.

Notice the difference in the reflections of the fruit in the table between the two renders.

Raytraced reflections can consume valuable render resources and time, so it’s a good

idea to make your scene efficient.

You can control the number of reflections on a per-object basis as opposed to setting

limits on the entire scene through the Render Settings window. To access a shader’s

reflection limits, select the shader in the Hypershade and open the Attribute Editor.

In the Raytrace Options section, drag the Reflection Limit slider to set the maximum

number of reflections for that shader. The lower value (either this value or the Reflections

value in the Render Settings window) dictates how many reflections are rendered for

every object attached to that shader. The default shader reflection limit is 1, so make sure

you change the Reflections value as well as each shader’s value if you want more than

one level of reflection.

Furthermore, you may not want some objects to cast reflections in a scene with raytraced

reflections. To specify that an object doesn’t cast reflections, select the object in a

Maya panel and open the Attribute Editor. In the Render Stats section, clear the Visible In

Reflections check box.

**Rendering Refractions**

Refractions are also a raytraced-only ability. Refractions require that an object be semitransparent so that you can see through it to the object (or objects) behind it being

refracted. To control refractions, use the shader. To enable refractions in either Maya Software or mental ray rendering, select the appropriate shader in the Hypershade and open the Attribute Editor. In the Raytrace Options section, click the Refractions check box. Now you need to set a refractive index for the shader and a refraction limit, similar to the reflection limit.

The refractive index must be greater or less than 1 to cause a refraction. Typically,

a number within 0.2 of 1 is perfect for most refraction effects. The first image in

Figure 11.13 is raytraced with a refractive index of 1.2 on the wine bottle and glasses; the

second image has a refractive index of 0.8 on both bottle and glasses.

You can specify whether an object is visible in a refracting object by clicking or

clearing the Visible In Refractions check box in the Render Stats section of the object’s

Attribute Editor. When rendering refractions, make sure the Refractions attribute under Raytracing Quality in the Maya Software tab of the Render Settings is set to at least 2 or higher; otherwise, your refraction may not appear properly. For mental ray, it is the Refractions attribute

found under the Raytracing heading on the Quality tab, as shown in Figure 11.13

(right). You will also need to set the Refraction Limit found under the Raytrace Options

heading in the Attribute Editor for the refractive shader in question.