5 Colouring Up

After you have achieved a line drawing of your product design, you are faced with the problem of what to do next. You are probably also considering what colours and finishes to use for the product and working against the clock to meet a deadline – the pressure is on. Before reaching for a marker, however, you need to be in the right frame of mind and you need to plan a great deal in advance.

Attitude

The most usual pitfall to avoid is being 'precious' about a drawing, to a point where you hold back and hesitate because of the risk of making an error. Obviously the nearer a drawing gets to being finished the more precious you will become. The first thing therefore is to be *bold*. Rendering is, in any case, a gross (but effective) simplification of reality; being bold about colour choice, tone, highlights, etc. actually makes it easier. It's like looking at the product through half-closed eyes, which eliminates all but essential details. If you are in doubt about anything, for example, how dark to make a shadow, or how light to make a highlight, then go several degrees darker or lighter than you judge is right.

If you are a beginner, approach the rendering in the knowledge that it will probably take two or three goes to build up your confidence to a point when you can attack the final version. For this reason, never work directly on your master underlay and, if possible, practise on photocopies or dyeline prints so that you don't have to constantly redraw it. Even when you are just sketching through ideas, try and maintain a fluid approach and never be afraid of consigning an effort to the bin. If you don't try, and trying means experimenting a lot, then it will take you a lot longer to improve.

The second attitude to develop is a strong sense of graphic balance. Every drawing you do is a complete graphic image which, like a painting, is subject to simple rules of composition. Obviously, the view you choose is very important but consider also how it is placed on the page and whether the colours are working well together. Look at the size of the image in relation to the page, and whether the general presentation of the drawing looks good. There usually comes a point where the overall quality of the rendering begins to take over from its original purpose, which is to present a design concept to your client. Don't worry about this because, to begin with, it is not an unhealthy attitude and in any case, as you become more confident, your sense of graphic balance improves to a point where it becomes almost automatic.

Probably the most important key to good rendering is observation. The more rendering you do, the more you will look at products around you and begin to understand why they look the way they do. This in turn will improve your ability to determine the disposition of tone, reflection and shadow in your drawing, and the better you get at this the more you will appreciate just how important keeping your eyes open really is. You will find yourself looking at objects in a different way, trying to work out why there is a reflection here or a highlight there. You will begin to understand why we perceive a colour as we do, and how it changes depending on its surroundings and the lighting. In absent moments you will probably find yourself looking carefully at complex reflections trying to work out exactly what is being reflected where and why.

The greatest single effect of your improved understanding of why things look the way they do will manifest itself in your design work, because you will begin to appreciate form and how shapes relate to each other; you will be able to see where formal decisions have failed in existing products and why a successful design works so well. Your visual vocabulary, or 'visual experience', will be greatly expanded, which will allow you to command more design options and so improve your ability as a creative designer.

The final point to bear in mind is economy. Remember that as a designer you are trying to give an impression of reality, rather than portraying reality itself. You want to put across an idea or design to your client, not impress him with the quality of your draughtsmanship. There is therefore no need to be absolutely faithful to rigid lighting conditions and accurate reflections; concentrate instead on using only those elements which help describe the finish or form you are trying to illustrate. The conventions which follow below may be clichés in the design world but that is of no importance to the client. Provided the client interprets the drawing in the way you intend, then you have achieved your objective.

Planning

Too many people believe that it is skill with this or that media that makes a designer good at rendering. Of course, this is important, but not as important as really understanding how reflections, colours, highlights and so on work. Designers who understand why we see things the way we do can turn their hand to any media, because they know what to draw. After that they will need constant practice with a new medium to perfect their rendering; as with perspective, practice really does make perfect. So there is no need to worry about your intended media too much at this stage.

Getting back to the blank sheet of paper, or uncoloured underlay – where do you begin? There are two basic approaches to be considered: the first, the more traditional way, concentrates on imagining the product illuminated by a single light source usually behind and to one side of the viewer, i.e. over the left- or right-hand shoulder; the second is to consider the product in terms of reflections.

The first method is indispensable for determining shadows and highlights but it is misleading, in my view, to think of the light as 'coming' from anywhere in particular. This is because the actual colour we perceive in a

product, be it a car or vacuum cleaner, is a function of four variables:

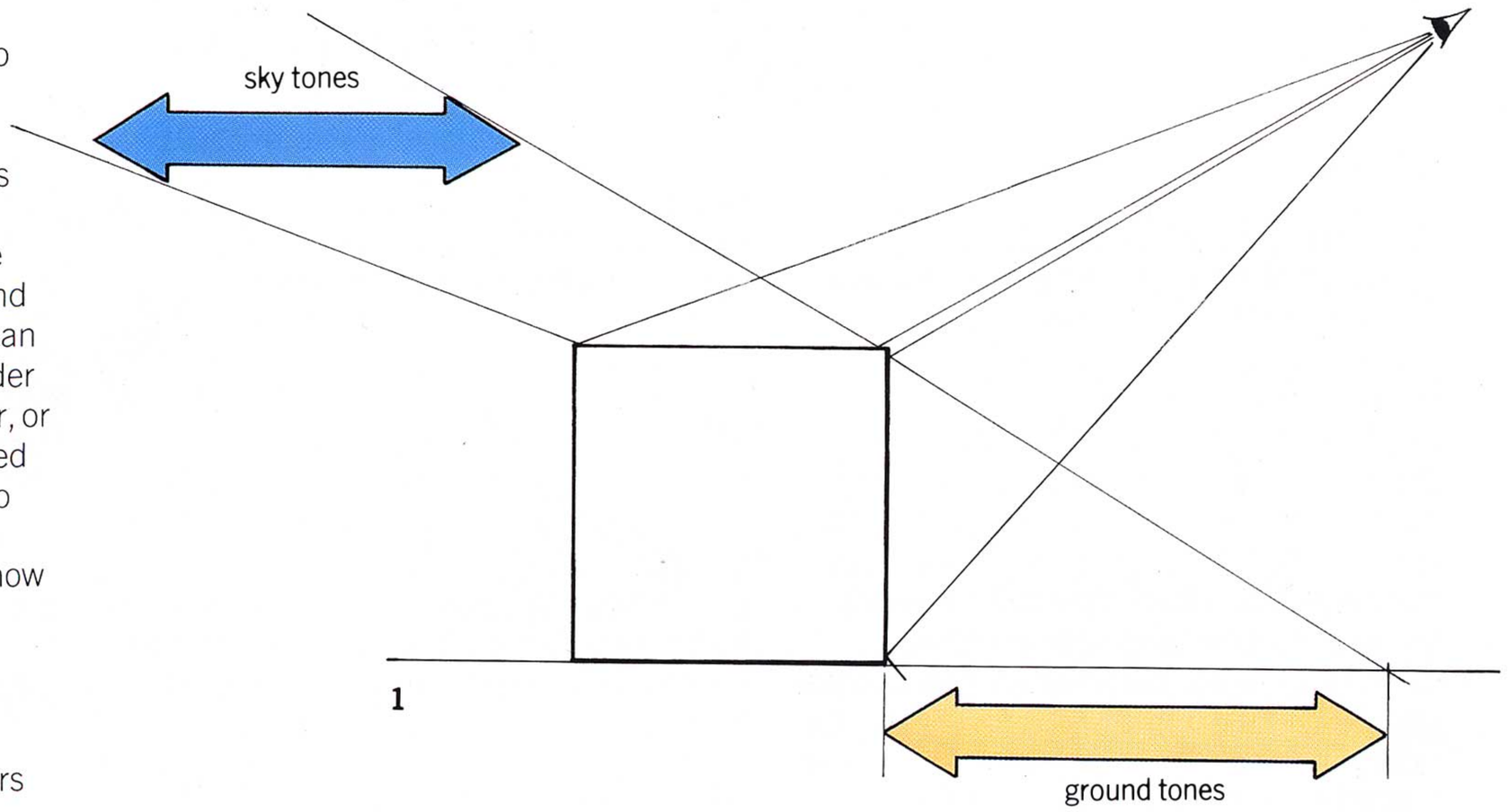
1. The intrinsic colour of the surface.
2. Its reflectivity and finish.
3. The colour and tone of its surroundings.
4. The location and intensity of light sources.

Of these four variables the first is a design decision while the second and third are more interdependent than the fourth. We shall come back to the exact light source later in the chapter but for the moment we will concentrate on reflected light. We must look at the line drawing and decide what is being reflected and where, and how best to portray it.

To do this we shall first consider some basic shapes and observe how their form is described with reflections and how matt (non-reflective) surfaces are subject to the same conditions. We shall also illustrate and explain some of the conventions that you can use in your own rendering. We shall consider each shape at its most reflective: i.e. mirror, or chrome, and then observe how the reflected image is identical in form, but not colour, to that seen in a gloss-plastic version; and we shall look at a totally matt version and see how it responds to the same reflected images.

Cube

1. This is a schematic representation of what you would see on the flat surfaces of a chrome cube. In each surface there is a specific area of the surroundings unaffected by distortion. In the top you will see an area of sky, or ceiling, and in the side you will see an area of the base immediately in front of the cube.



1

Cube

The chrome cube has no colour; the colours we see in it are entirely a function of its surroundings. Each surface is effectively a mirror which reflects in full colour and without distortion objects, landscape and light sources around it, but the 'picture' we read in each surface represents only a limited part of the surrounding environment. The easiest way to work out what is happening on these surfaces is to make a cardboard cube and laminate some mirror-finished polyester film, like Mylar, to each face, or simply hold a small mirror as if it were the side of the cube. Try placing it on a sheet of gridded paper, and move coloured shapes up to the surface, watching all the time what happens to the reflections. Try and cast a shadow onto the mirrored surface and you will find it very difficult. Observe how anything at right angles to the surface appears to pass right through.

You can see that if you wanted to draw a chrome cube you would first have to imagine it in its surroundings, and probably actually draw some of those surroundings. (To find out how to do this, refer to p. 59.)

If we now imagine a highly polished, gloss-plastic cube, it too reflects in exactly the same way as the chrome cube. The same images we saw in the sides of the chrome cube can be seen just as crisply delineated in the plastic version. They are also sharp, pictorial reflections, but, unlike the chrome cube which reflects in full colour, they are made up out of the tonal range of the cube's intrinsic colour. Test this by finding something with a flat, polished and coloured plastic surface (a piece of coloured acrylic is ideal) to compare with the mirrored cube above. Take a red, yellow and blue coloured pencil and try holding them at right angles to the surface of the mirror – the reflected image is perfect in every detail including colour. Next, try them against the polished plastic – the shape and crispness of the reflection is the same but most of their intrinsic colour is lost. Exactly how much of this colour is reflected depends on the colour of the base material, but for rendering purposes you can ignore the subtleties of reflected colour and use a tone of the base colour. There is one small exception to this guideline and that is gloss black, which reflects a lot of colour. This may be one occasion therefore when you need to go further than simply using the tonal range of the base colour. The more experienced and confident you get, the more you will begin to exploit the potential of reflected colour; but for the moment it is best to ignore it.

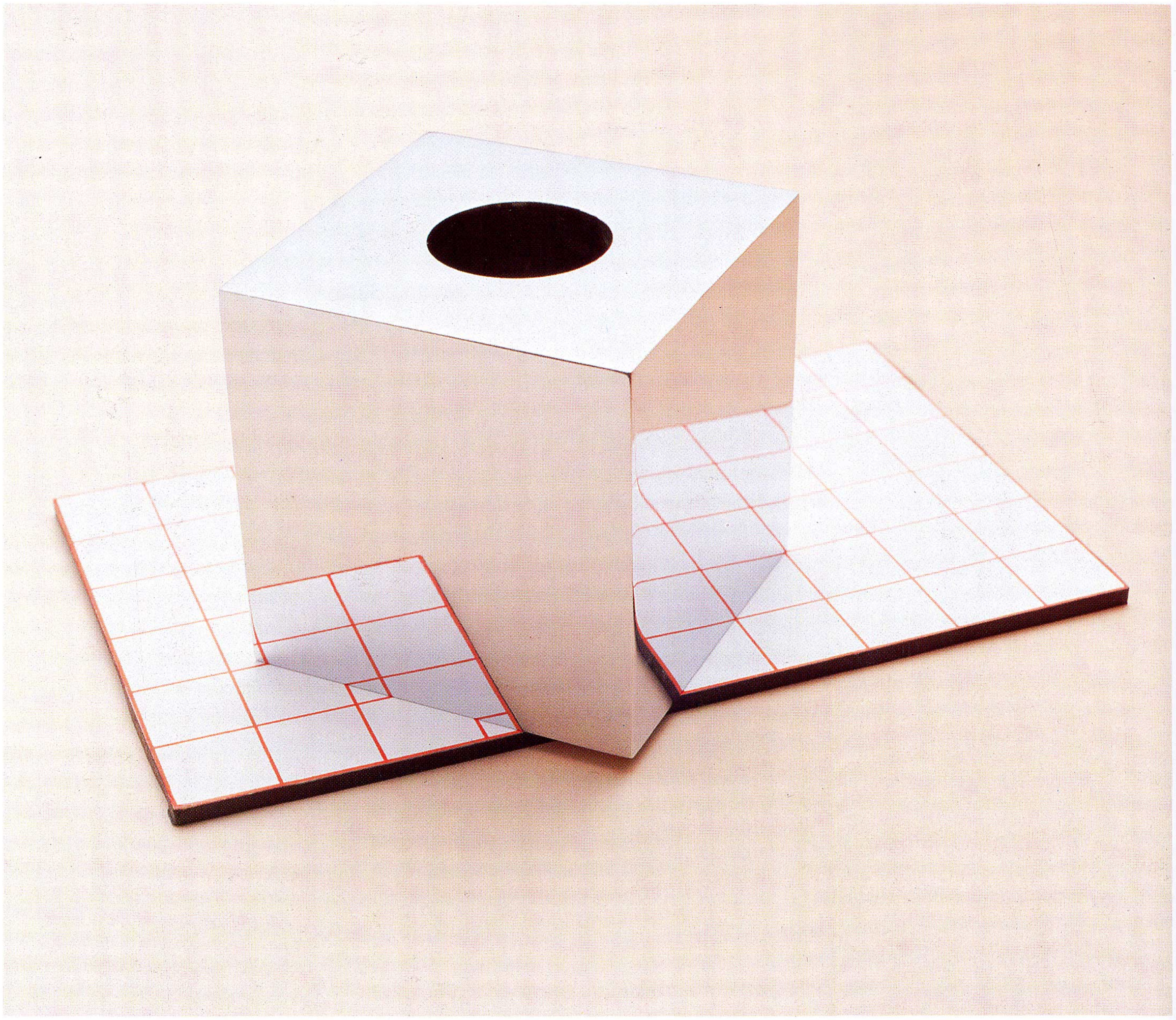
Remember also that, with super-glossy, coloured surfaces which have been lacquered, the more acute your angle of view to the surface the more reflected colour you will see, and the closer it comes to a right-angle the more intrinsic colour you see; at low angles of incidence the glossy lacquer is very reflective and you see the surroundings, but when viewed directly from above you see right through the lacquer to the underlying colour. It is important to understand this when rendering glass and other transparent, or semi-transparent, materials, as they behave in exactly the same way.

So, to draw a glossy plastic cube you need to think of it in exactly the same way as the chrome cube, which means considering each surface in terms of its reflections. At the other end of the scale you should study a matt-black cube to see how it might look in similar circumstances. Before you do, however, it is important to understand why the matt surface looks matt and why the

polished surface is reflective. The polished surface (and the mirror is the perfect example of this) is absolutely flat. If you look at it under a microscope, you will see that the absence of surface aberration allows light to reflect off it in a coherent and predictable way. The matt surface, however, when seen under the microscope, is finely textured and pitted, which scatters the reflected image in all directions. This makes it impossible to read the reflected images because they become blurred and indistinct. Only the brightest of images, such as light sources, will be seen.

If you repeat the experiment with the coloured pencils against a flat matt surface, it is very difficult to see any reflection. Next, position a light source so that you can see its reflection and watch how the image which is sharp and crisp on the glossy surface is blurred and diffused on the matt one. This effect is especially important when drawing matt finishes because highlights (that is concentrated areas of reflected light) are ill-defined and soft compared to their glossy counterpart.

To sum up then, you should consider each surface of the cube separately, whatever its finish, in terms of what is being reflected. I usually treat the top, upward-facing surface as the lightest because it reflects the sky, if outside, and the ceiling complete with lights, if inside. Both the remaining faces will be darker and one will be darker still. Usually the larger of the two gets the lighter treatment but this can depend on which side of the product needs most emphasis. You can apply this method to any rectangular product even if it is multi-faceted – just remember that every plane which faces in the same direction will reflect approximately the same information and will, therefore, be similar in its tonal value.



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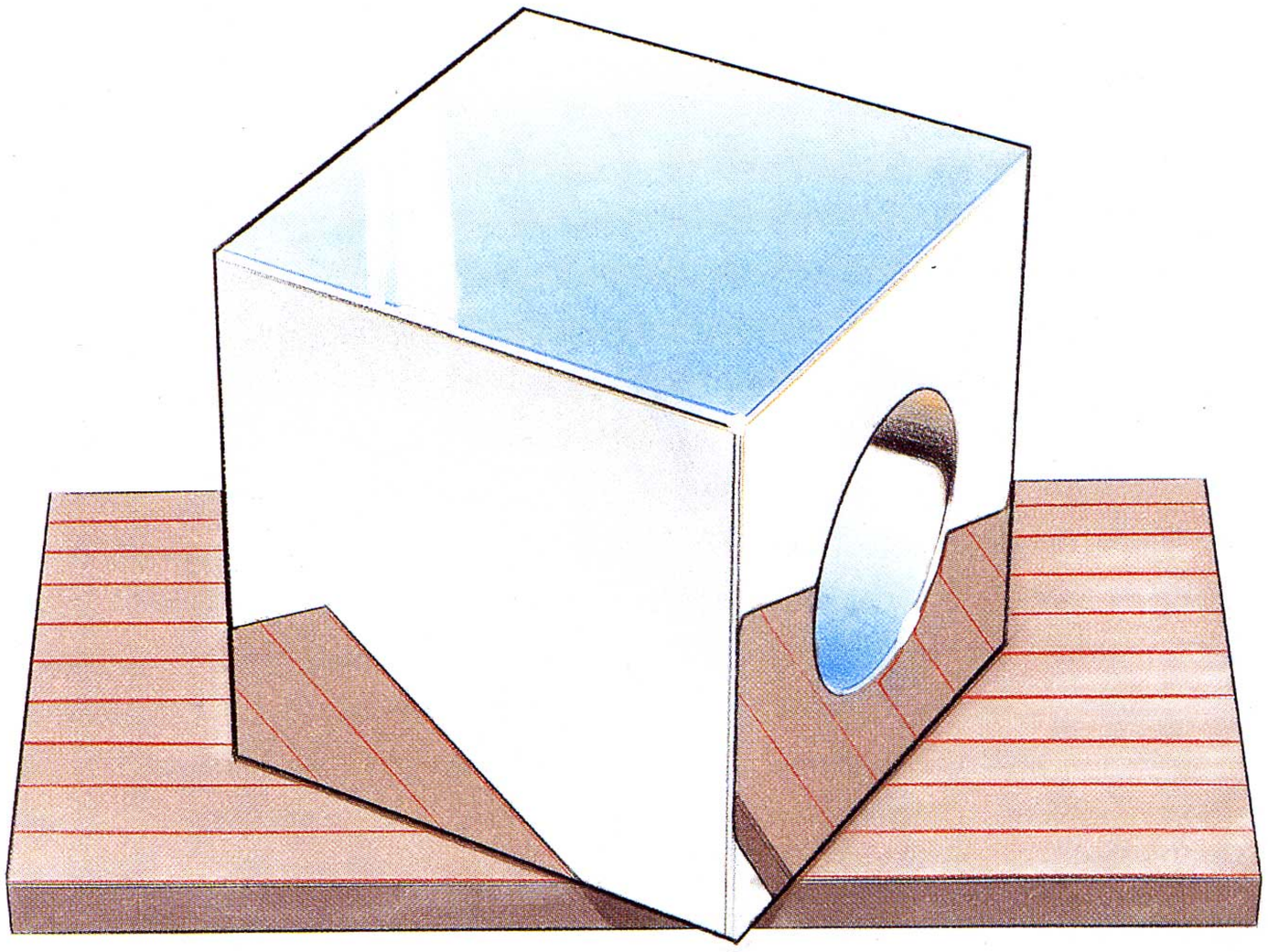
Cube (cont.)

2. In this chrome cube, shot in a photographer's studio, the top surface, apart from the black hole, is reflecting the 'sky' (actually a large light) above, and the two sides are reflecting their respective parts of the gridded rectangle and the beige paper on which it sits. Note how, on the near right-hand corner, the reflection of the rectangle is 'pulled', or distorted, into the edge giving it an almost liquid appearance.

3. The view of this chrome cube is the same as that used later to construct reflections (see pp. 59–60), so that you can see how these were built up. It is impossible to give a good impression of a chrome cube without drawing at least some of the surroundings. In other words, if you were to take away the block on which the cube sits, the viewer would make very little sense of the reflections. The top is reflecting sky, and the hole through the middle is reflecting ground at the top and sky at the bottom; in between is the horizon. The reflections are crisp and sharp, and the corners (which, like those of a radiussed cube, focus and compress the surroundings) are strongly contrasted.



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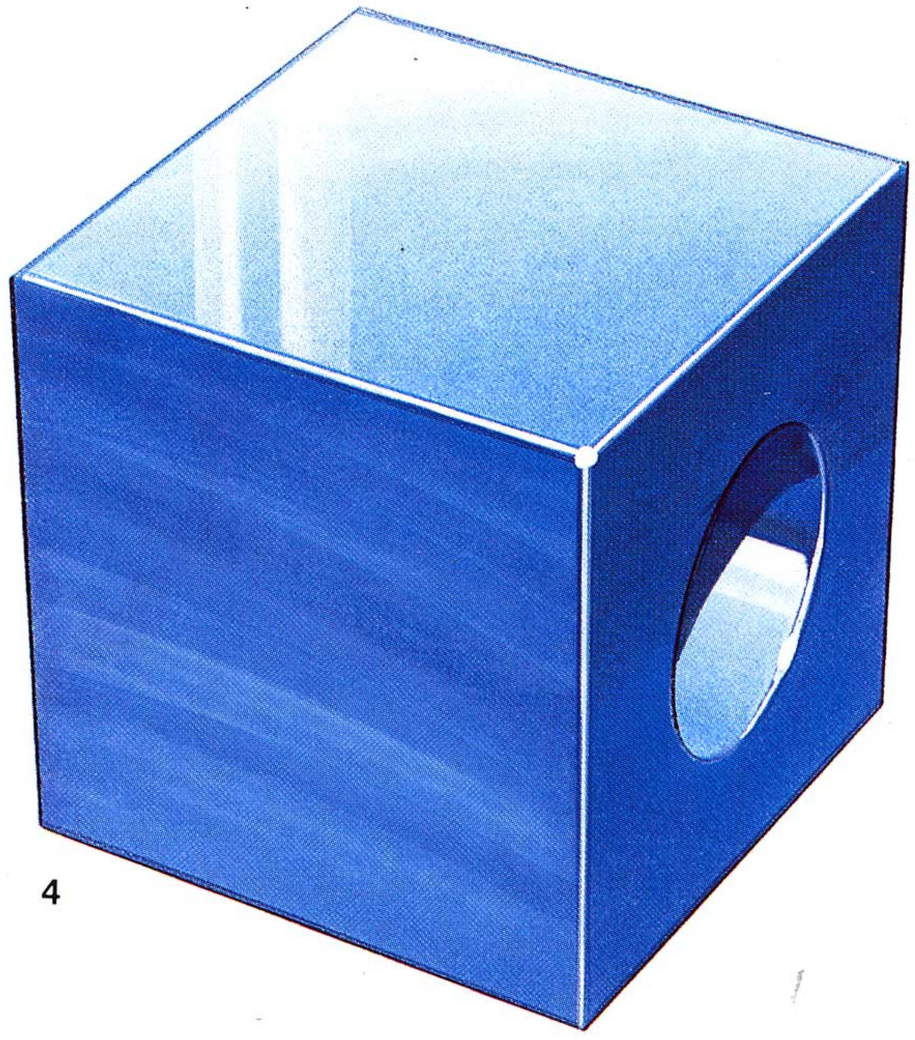
4. With gloss plastic it is not really necessary to go to all the bother of constructing the reflections, as a good impression can be obtained from a more general approach. (However, if you had placed the cube on the same block as before, then you would see exactly the same reflections but in tones of blue). Each face is treated separately: the top is reflecting sky, or ceiling, and has a vertical window reflection running across it. The nearside face is considerably darker and is graded slightly so that it is lighter at the bottom. The face with the hole through it is slightly darker still and is also graded towards the bottom; this is to give the most contrast at the top edges where the highlight runs; the highlight itself is backed either side with a dark crayon to make it appear brighter. The hole is exactly as in the chrome cube but with a shadow across it.



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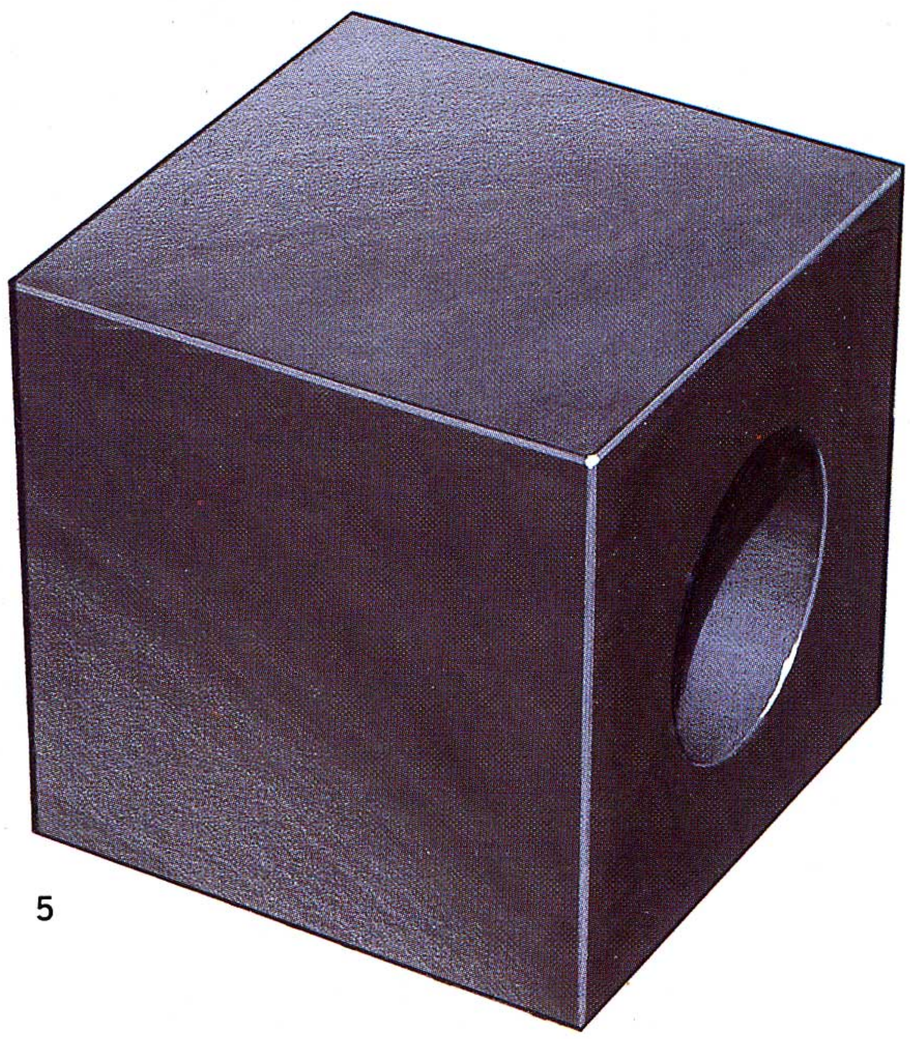

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5. With the matt-black cube all the reflections are lost leaving only a gradual tone across each face. The top face is lighter still and slightly graded from front to back. The hole now has a fuzzy instead of a sharp highlight although the shadow across it is still crisp.

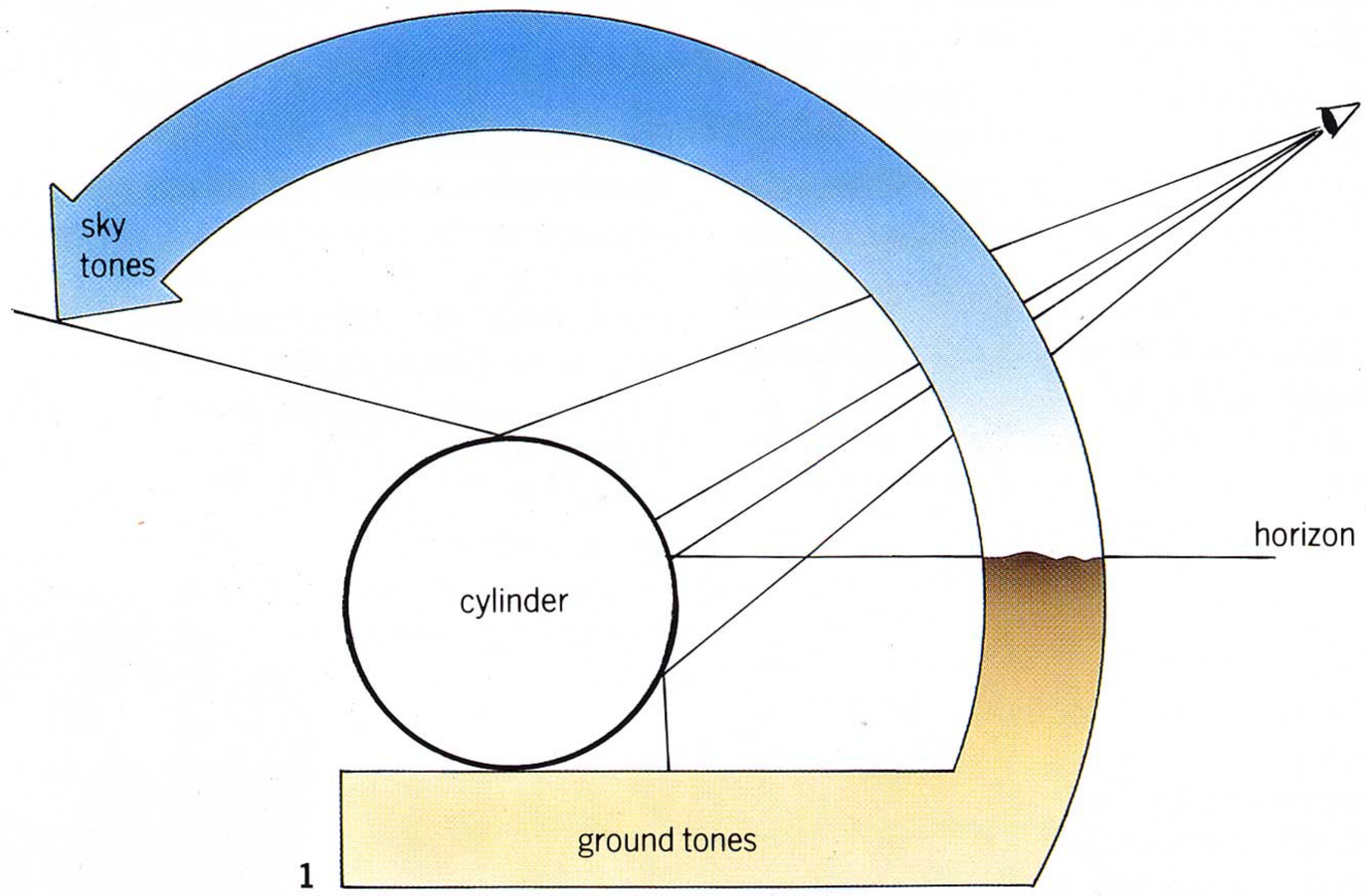
Cylinder

Having seen how a completely flat surface reflects, we must now look at what happens when a surface is curved in a single plane. This is best explained by looking at a simple geometric cylinder in the same context as the cubes.

Horizontal cylinder

1. This is a schematic representation of the 'desert cliché' – what you would see in the side of a chrome cylinder with the sky at the top, the ground towards the bottom and the horizon in-between.

2. This cylinder was photographed in a studio but illustrates the desert cliché well. We were unable to simulate the sky, so, as with the cube, we had to use a large light with a piece of blue graded paper tacked onto it. Note how the flat end of the cylinder reflects an undistorted image of the surroundings.



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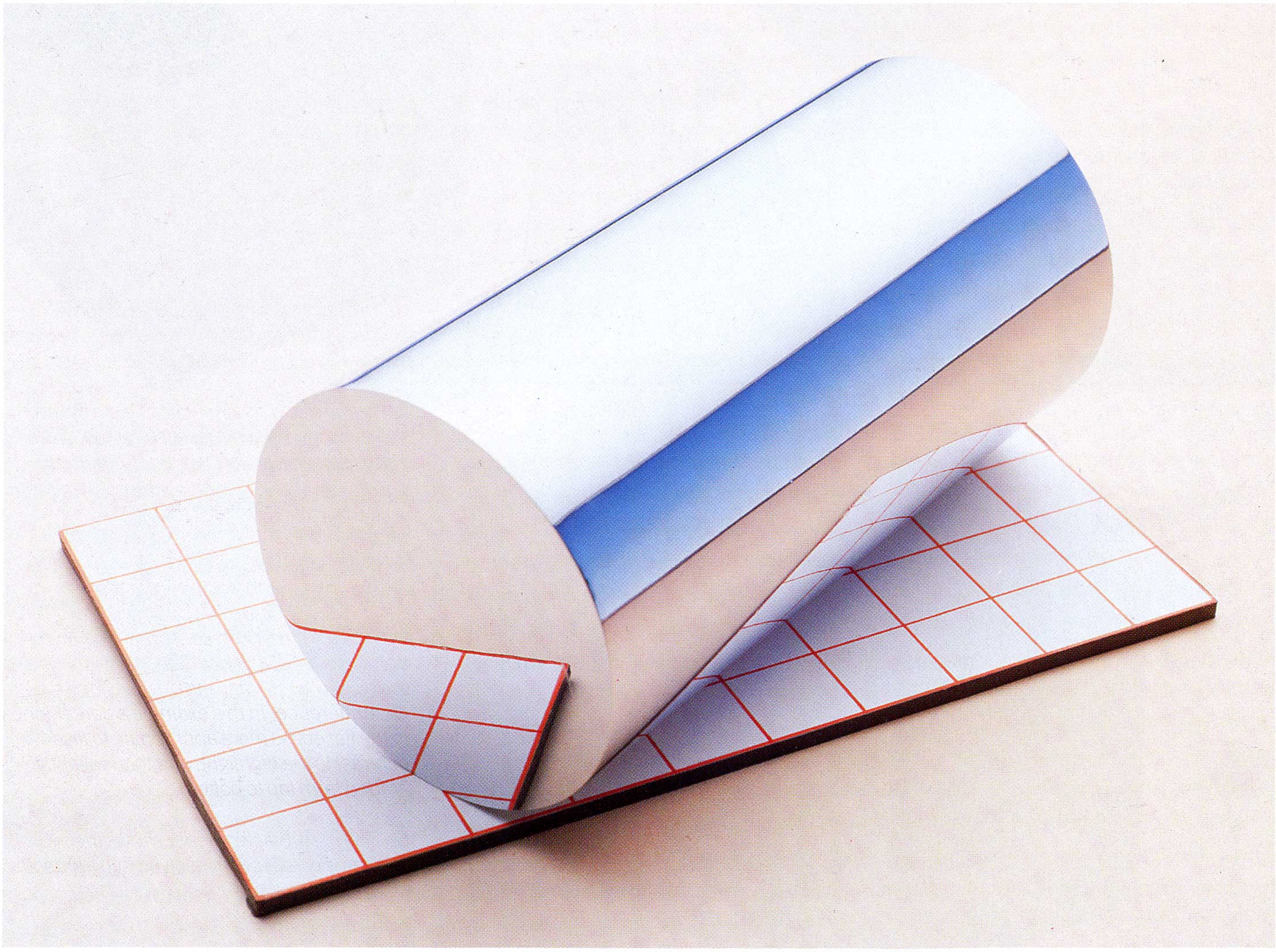

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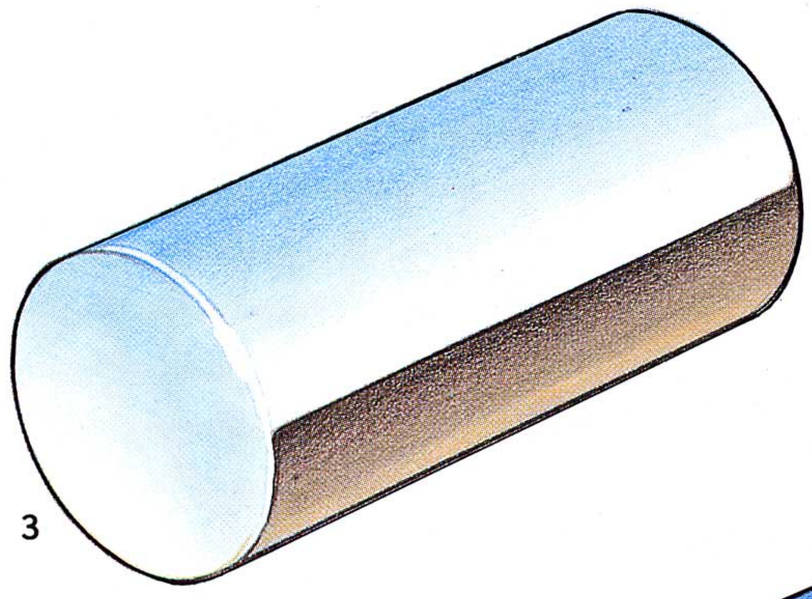
We have seen how chrome, because it is the most reflective of materials, can give us all the information we need to understand other finishes. So let us consider first what we might see reflected in the surface of a chrome cylinder. This is best understood by imagining a chrome cylinder laid horizontally in the artificial and uncomplicated environment of a desert, with you, the viewer, looking down at it. What you see in the surface of the cylinder is a distorted view of the surroundings. At the top of the curve you see the sky, in the middle you see the horizon, and as your eye scans the lower part of the curve you see the desert floor being reflected. As your eyepoint moves up and down, so the horizon moves up and down as well. In very reflective surfaces, like chrome, there tends to be great contrast between lights and darks, so imagine that it is dawn or dusk in the desert, with the sun low on the horizon. This throws the horizon into dark shadow and, with the sky above it at its lightest, produces a very high contrast. The colours in the reflection, as in the cube, are exact and true to the real image. I call this reflection the 'desert cliché', and it can be applied to chrome in almost any situation. You can see it in any glossy curved surface, especially in the sides of cars where glass and polished paintwork reflect strongly. Often it is not the true horizon (in a perspective sense) that is reflected but the roofline of adjacent buildings. It is perhaps best to think of it as a positive and high contrast change between light and dark.

Of course, many products are for interior use, so there is unlikely to be a true horizon to be reflected. However, the effect is still easy to see, often as a table edge, or simply the border between light and dark. Most commonly it is a window being reflected and because the window is usually the brightest part of the room the wall in which it is set is the darkest. This, as in the desert, provides the high contrast and 'edge' that makes reflective surfaces look reflective.

Turning the cylinder through 90 degrees produces a very different reflection, when viewed from above. The horizon will not be visible until you drop your viewpoint to horizon level; instead, the surface reflects a distorted view of the desert floor which appears to wrap around the cylinder. This is best observed by taking a small section of chromed tube and placing it, end-on, on a piece of gridded paper. With tubes of a large diameter the reflections can become quite complicated (see photo on p. 56), but with thin tubes of small diameter the reflections typically resolve into a series of dark and light verticals. In tubular chrome furniture, for example, it is often best to suggest the reflective finish in the horizontal elements and at the changes in direction and leave the verticals almost untouched. Alternatively, it is sometimes possible to get away with the desert cliché on verticals with no loss of credibility to the drawing.

The gloss-plastic cylinder, of course, whether horizontal or vertical behaves in exactly the same way as the chrome version but, like the cube, reflects in tones of its intrinsic colour rather than in true colours. The horizon will probably be the darkest area, and the sky will be reflected as a light tone at the horizon, getting slightly darker as it wraps around. Below the horizon the desert floor will be a dark tone becoming lighter as it wraps around away from us.

The matt cylinder reflects exactly the same environment but, as with the cube, the information is blurred and indistinct. The light source, in this case the area above the horizon, will be seen as a hazy highlight running along the cylinder. The graduation of tone around the surface will be much more subtle and appear as a consistent change of value as it wraps around.



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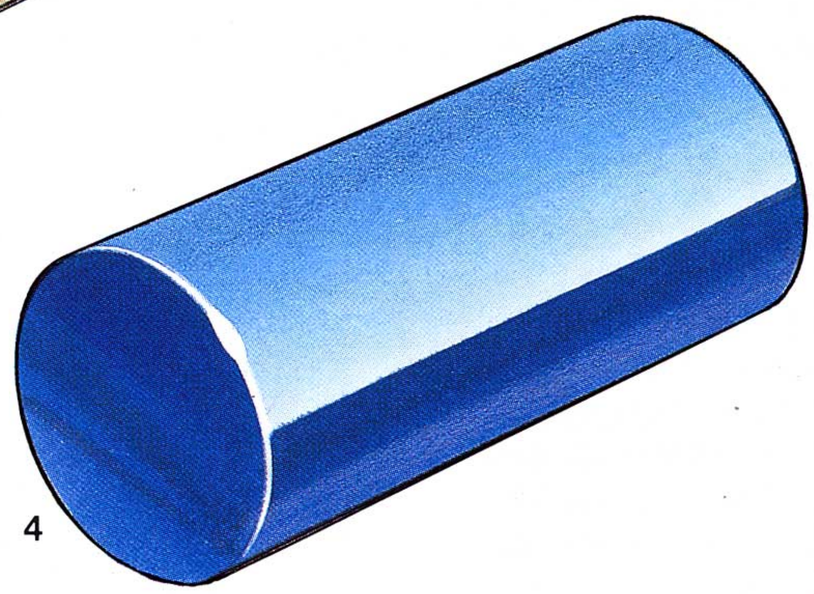

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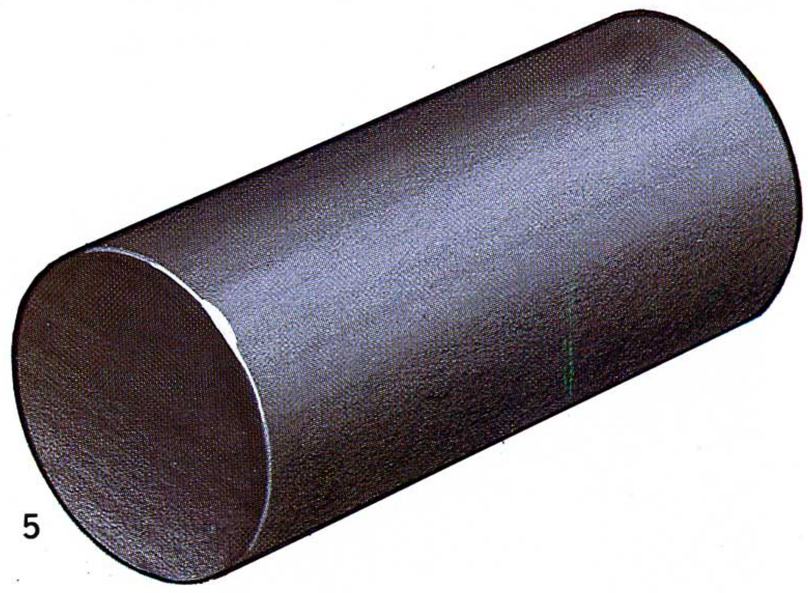

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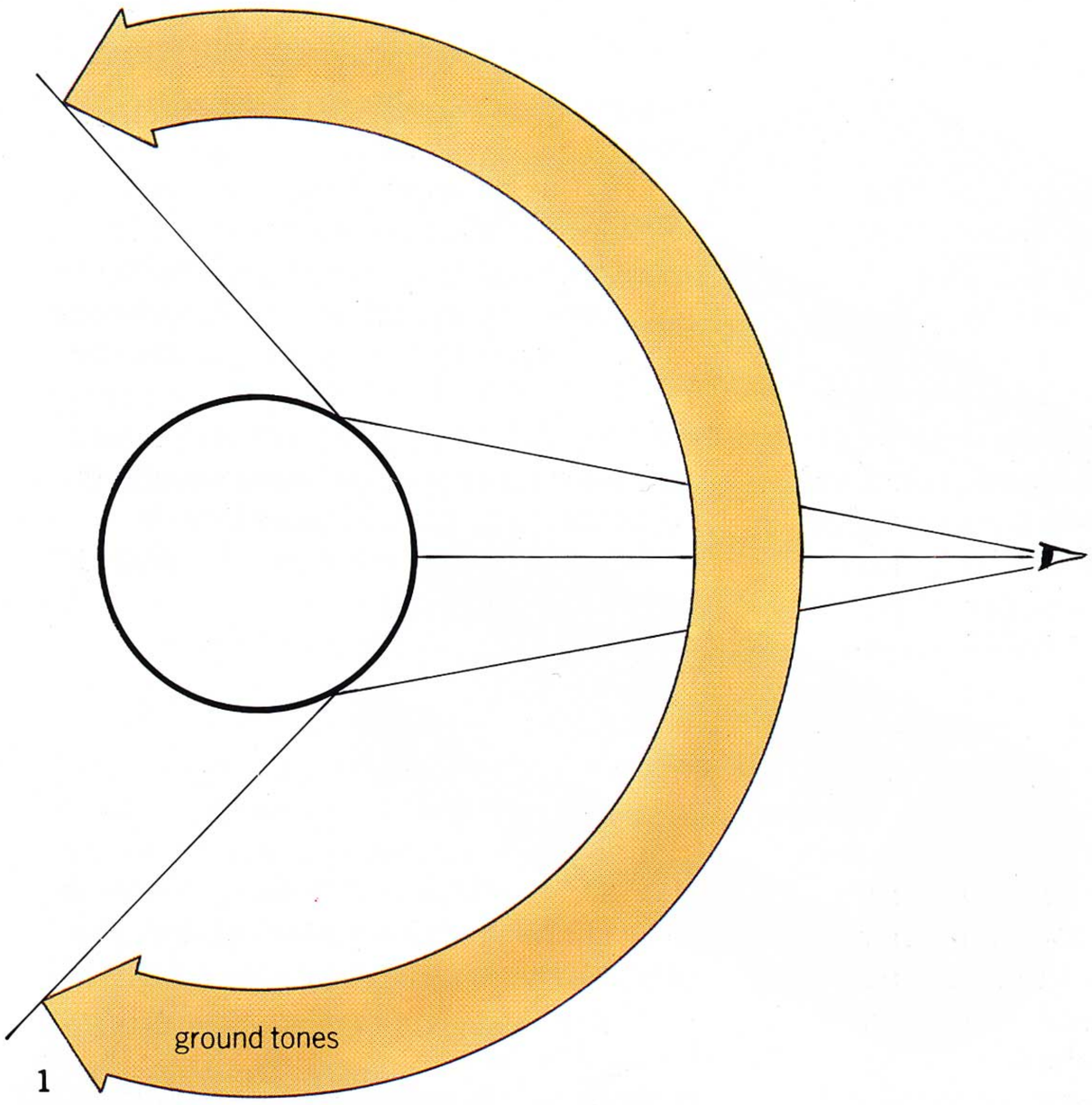
3. In this rendered visual of the chrome cylinder you can clearly see the desert effect. The flat end did not look quite right with just a flat sandy colour being reflected (it is difficult for the viewer to make sense of the reflected image without seeing the real one) so, since chrome appears predominantly black and white, this was left white with some blue to provide contrast to the highlight around its circumference.

4. In the gloss-plastic version the same desert effect, with a sharp horizon, can be seen. Note how, like the chrome version, the horizon is 'pulled' (distorted) into the little radius where the highlight runs around the circumference. In this example a darker tone in the flat end is more appropriate to give contrast to the highlight, and this is slightly graded from top to bottom.

5. The matt-black cylinder shows the horizon/sky reflection resolved into a smooth tonal transition.



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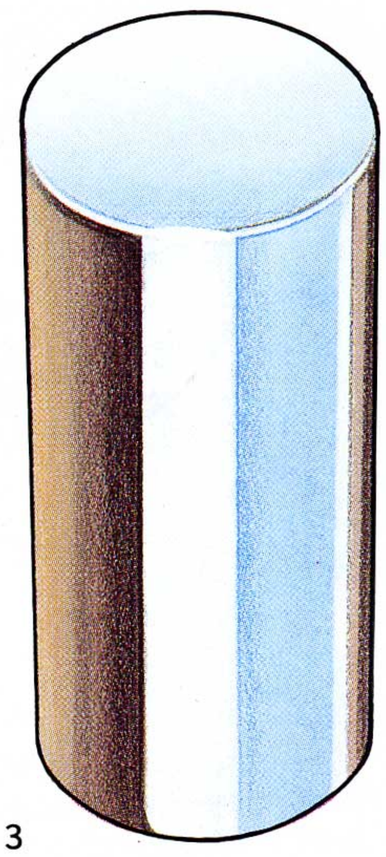

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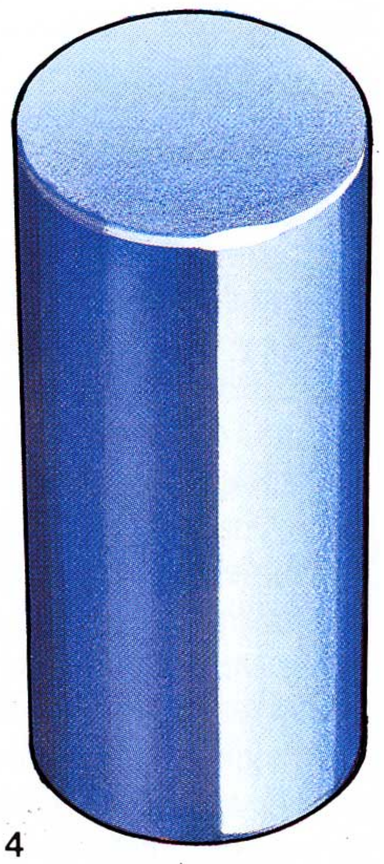

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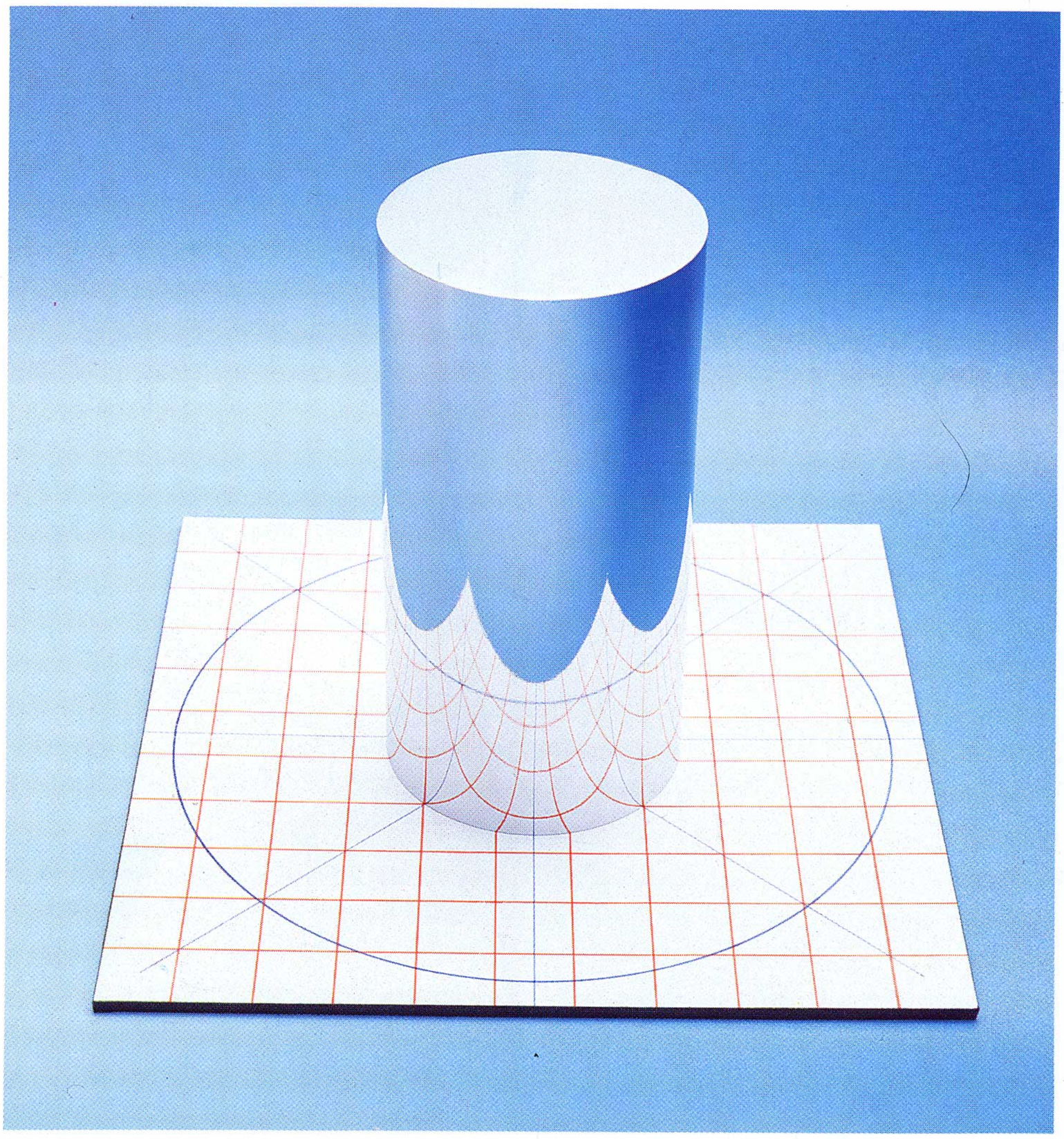


2

Vertical cylinder

1. Maintaining the high viewpoint on the cylinder but turning it through 90 degrees produces a very different effect. All you can see in the cylinder is a distorted view of the desert floor. If you lowered your viewpoint so that it was perpendicular to the vertical face, you would be able to see almost all the horizon, with yourself in the middle foreground.

2. The photo shows how, with a fairly high viewpoint, the surface of the cylinder reflects the ground around it. You can see how even the two back corners of the square are just visible. Note, too, how the red squares and the circle drawn on the base, are reflected.

3. The rendering of the chrome cylinder shows how it is possible to use the desert cliché without losing credibility, and without the need to draw in the base. For maximum realism it should have been drawn, like the cube, on a surface which could have been reflected. In practice, though, this is extremely difficult to do and you are as likely to get it wrong as right. As a compromise I have, in the past, used the distorted corner to suggest a base surface.

4 and 5. As with the other examples, the gloss-plastic cylinder is exactly the same as the chrome but in tones of blue, and in the matt-black version the highlight is resolved into a hazy, but smooth, tonal transition.

5

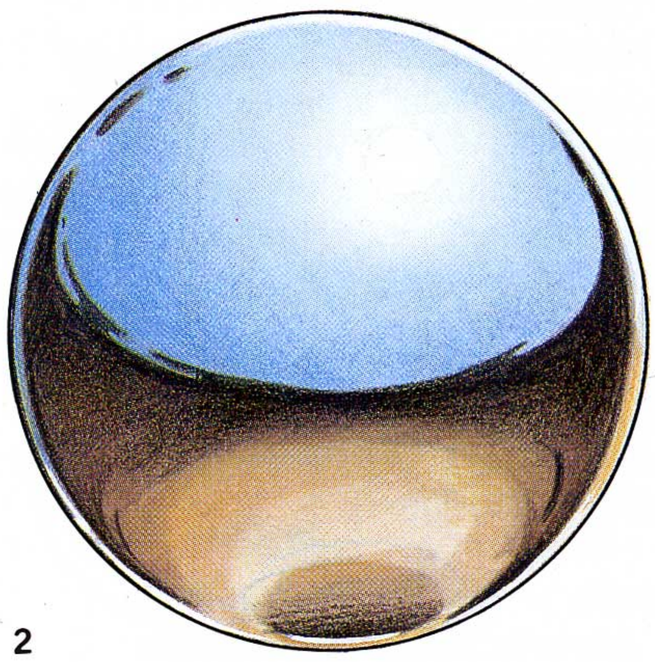
Sphere

The sphere combines the effect of the cylinder in a horizontal and vertical position, producing a reflected image of the surroundings which is distorted, like a fish-eye lens. The reflections appear most distorted near the edge of the sphere and least distorted on a line drawn from your eyepoint through to the centre. As with the previous examples, it is easiest to imagine a chrome finish in the desert and work out in side and top elevation exactly what is being reflected. You will see the high-contrast horizon relatively undistorted in the middle but being 'pulled' and 'stretched' as it nears the edge and your view is more tangential to the surface. In the immediate foreground you will see the desert floor and you, the viewer, and right at the bottom a reflection of the sphere's own cast shadow, while above the horizon is a complete vista of the surrounding sky. As with the other examples, the gloss-plastic sphere reflects the same images but in tones of its true colour and the matt-black version resolves all the reflections into a smooth tonal transition.

Reflections in any compound curved surface are difficult to predict but as your experience builds up you will become more and more adept at it. It is very useful to keep a selection of reflective shapes which you can refer to; for example, a polished billiard ball or a silver spoon (which gives both convex and concave reflections). I also keep a couple of mail-order catalogues because there is endless visual reference in there for all kinds of shapes and finishes.

Sphere

1. The reflections in a sphere are a combination of those seen in the vertical and horizontal cylinders. This photograph of a sphere, shot in a studio, was specially set up in order to simplify the reflections. (Since the sphere reflects like a large fish-eye lens, the photo would otherwise have shown the entire studio complete with the photographer and his camera.) Note how the red squares are distorted as they wrap around the surface.



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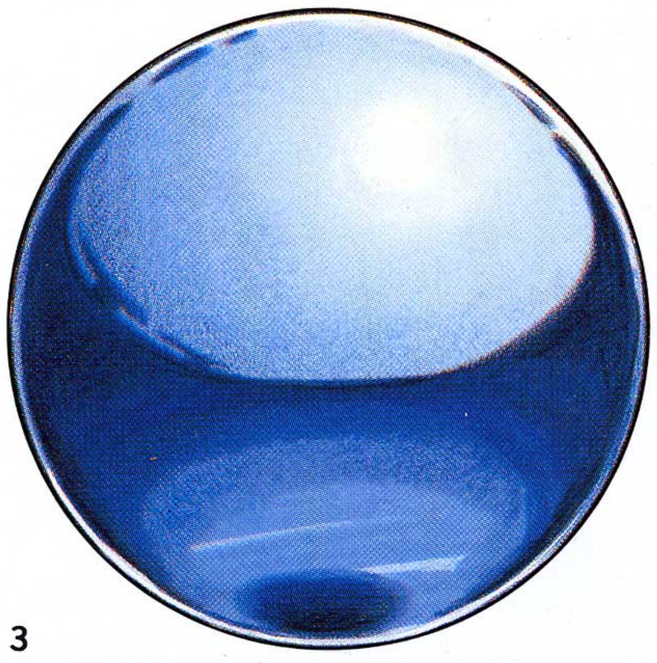

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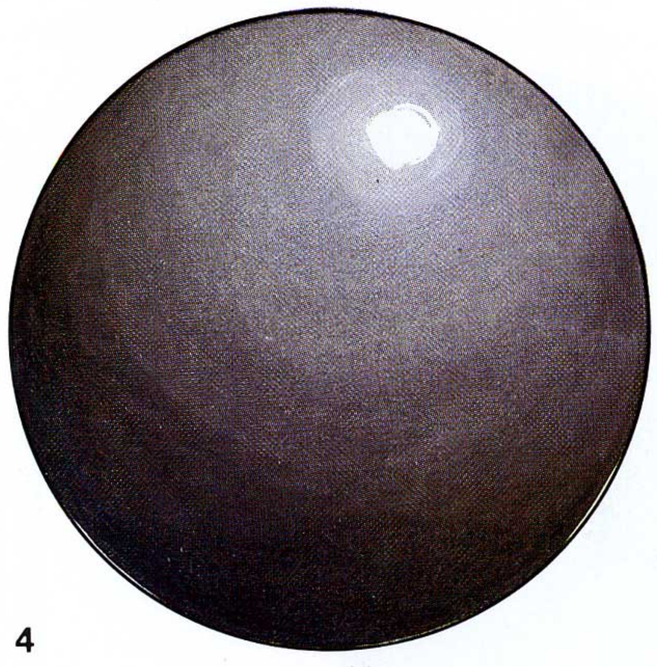

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Sphere (cont.)
2. The chrome sphere shows the horizon being distorted as it nears the edge, with the desert floor being reflected in the lower hemisphere. In this case the sun (highlight) is higher in the sky and can be clearly seen.

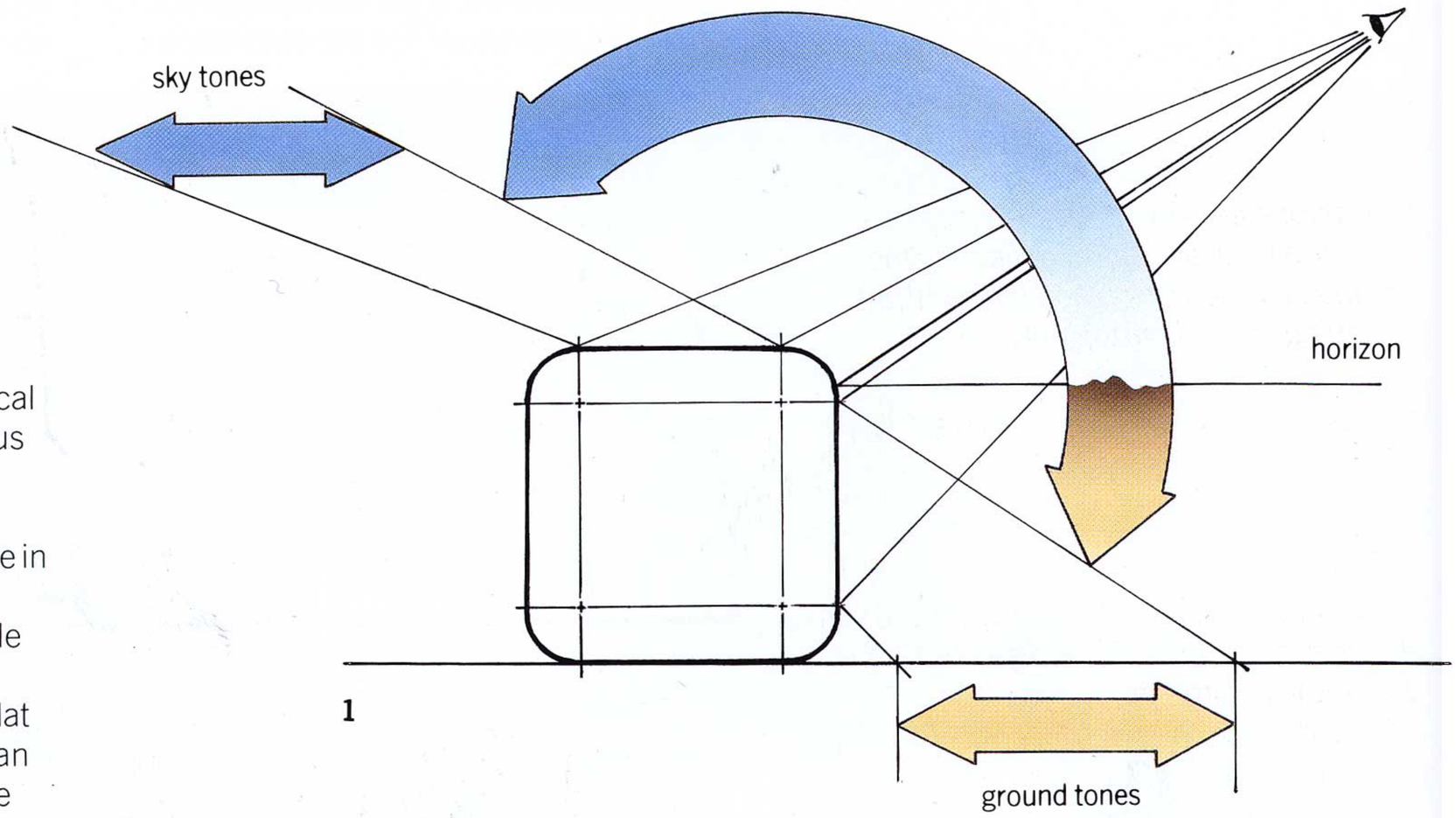
3 and 4. The gloss-plastic sphere is, of course, identical but in tones of blue, while the matt-black one is continuously toned from the highlight outwards.

Radiussed Edges

Armed with these three basic examples of how reflections work we can begin to combine them into more product-like shapes. Perhaps the most typical of modernist forms is the flat-sided geometrical shape with radiussed edges. In the previous chapter we constructed a cube with radiussed edges and I referred to the usefulness of this constructional technique in determining the disposition of reflections.

First, consider the radiussed cube in side elevation, breaking it down into flat, cylindrical and spherical surfaces. In the flat side of the cube you will see, like a mirror, an undistorted image of another section of the surroundings (probably the ceiling or sky). Between these two areas, the radius is reflecting a total picture of the remaining environment. If you could walk across the surface, you would see every detail of those surroundings; the radius has the effect of focusing this large amount of information into a very small area. This is why radiussed edges often appear very bright, as highlights.

Note that in the side elevation the rate of change from flat surface to radius is gradual at first so that the horizon (or highlight) does not occur at the line where the radius starts, but some way up its surface. Note also that if this were a matt-finished cube we would read one tone on the top surface and one (probably darker) in the side. Between the two there would be a gentle and consistent graduation to a bright but hazy highlight.

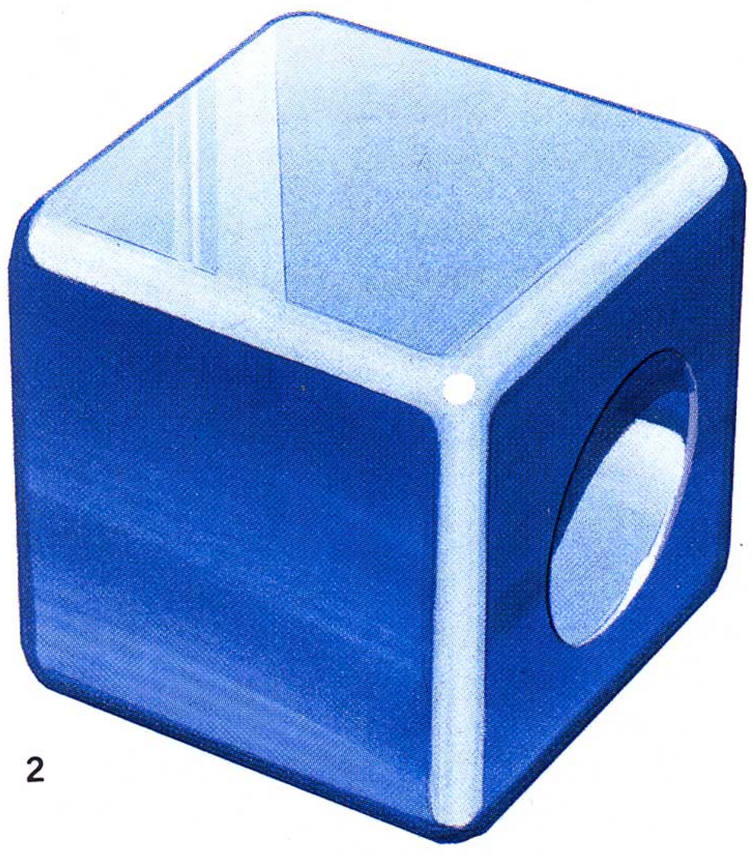


1

Apart from the desert/horizon convention there are some other useful and easily controllable reflections which can be used to advantage.

Radiussed cube
1. This schematic diagram illustrates what you might see if you looked down upon a radiussed cube. In the front face there would be a reflection of a limited part of the surface on which the cube is sitting; this would be distortion free. In the flat area of the top face you would see an undistorted image of the sky, or ceiling. In the radius between these two flat planes you would see everything else. This is why you tend to get highlights on radiussed edges; for example, if the sun was in the sky behind you, you would see it being reflected in the radius even if you moved your viewpoint lower down or higher up. For the same reason the radius has a focusing effect, picking up many individual lights (spotlights on a track for example), and resolving them into a band of light that is brighter than the rest of the cube.

A common mistake among students rendering radiussed edges for the first time is to draw the highlight as broad as the radius. Because the curvature of the radius from the vertical is gradual, the horizon normally lies slightly above the imaginary line which defines the end of the flat plane and the beginning of the radius.



2

2 (Above). Tonally, this gloss-plastic radiussed cube is the same as the one on page 53 with the top reflecting sky, etc. The radii are treated as three broad highlights; note how they are 'pulled' in that characteristic liquid look as they reach the back corners. Giving all three highlights equal brightness is the easiest way to render the radii, but they could have been treated differently, with the vertical probably being a similar tone to its two adjacent sides (it is, after all, a vertical cylinder reflecting the ground on which it sits) and the highlight sweeping around the top only.

Reflections in a Flat Surface

As we have seen, a flat reflective surface behaves exactly as a mirror. That is, it reflects a true, undistorted image of a fixed part of its environment. It is easiest to understand this everyday effect by positioning a pencil at 90 degrees to a mirror and looking at the reflection. It appears as if the pencil passes straight through the mirror surface, and the apparent length of the reflected pencil is the same as the original pencil (in perspective, of course, because of the effects of diminishing distance). This effect is the most predictable of all reflections and can be used to construct more complicated reflections on those occasions when absolute accuracy is important. The adjacent illustrations show how to construct simple reflections in the side of a cube.

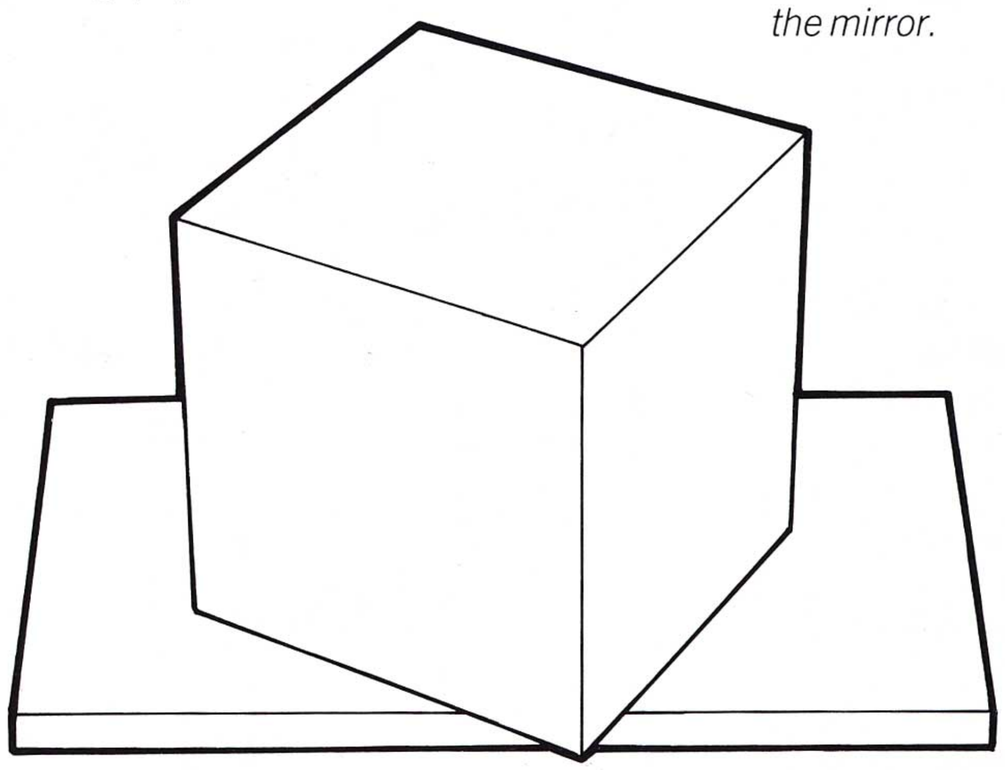
If, however, you had chosen to sit the cube on a small circle (which, in perspective, appears as an ellipse), then, after constructing a circumscribing square around the ellipse, you could use the same basic technique as that illustrated to construct the reflection of the circumscribing square. Once this is done it is very simple to lay in the ellipse within it.

Below: Constructing reflections in a flat surface

1. To get the feel of this single and obvious reflection, construct a perspective cube (as described in the previous chapter) sitting on a block. We need to work out where, in each face, the reflection of the block will appear.

2. The easiest way to do this is to treat each vertical face completely separately and, whichever one you choose, imagine it as part of a much larger mirror and extend its base line accordingly. Ignore the rest of the cube for the moment and concentrate exclusively on this 'mirror face'. Mark off a series of lines (shown in red) along the base, that pass through the mirror face (shown in blue) and are at right angles to it in perspective. This means they will share the same vanishing point as adjacent faces of the cube. Where a line crosses a detail on the base, in this case the edge, a point (X) can be marked off; you can then estimate the position of the reflection of this point (X^1), as it will lie on the same construction line and at an equal distance in perspective on the other side of the base line. It is as if this point has been rotated through 180 degrees to give a symmetrical point about the base line of the mirror. Remember that where a line actually meets the mirror face (A and B) its reflection starts at this point.

It does not matter at this stage where you draw the red/blue lines because you quickly learn to recognize the important points to be reflected and put the lines through these key points. In this example, you do not really need all the red/blue lines, only the one which runs through point Y, which helps you to locate Y^1. Joining Y^1 to A and B would construct the reflection. If, however, line YB was wavy or there was a complex pattern on the base, you would need all of the red/blue lines. Note that the thickness of the base is also reflected in the mirror.



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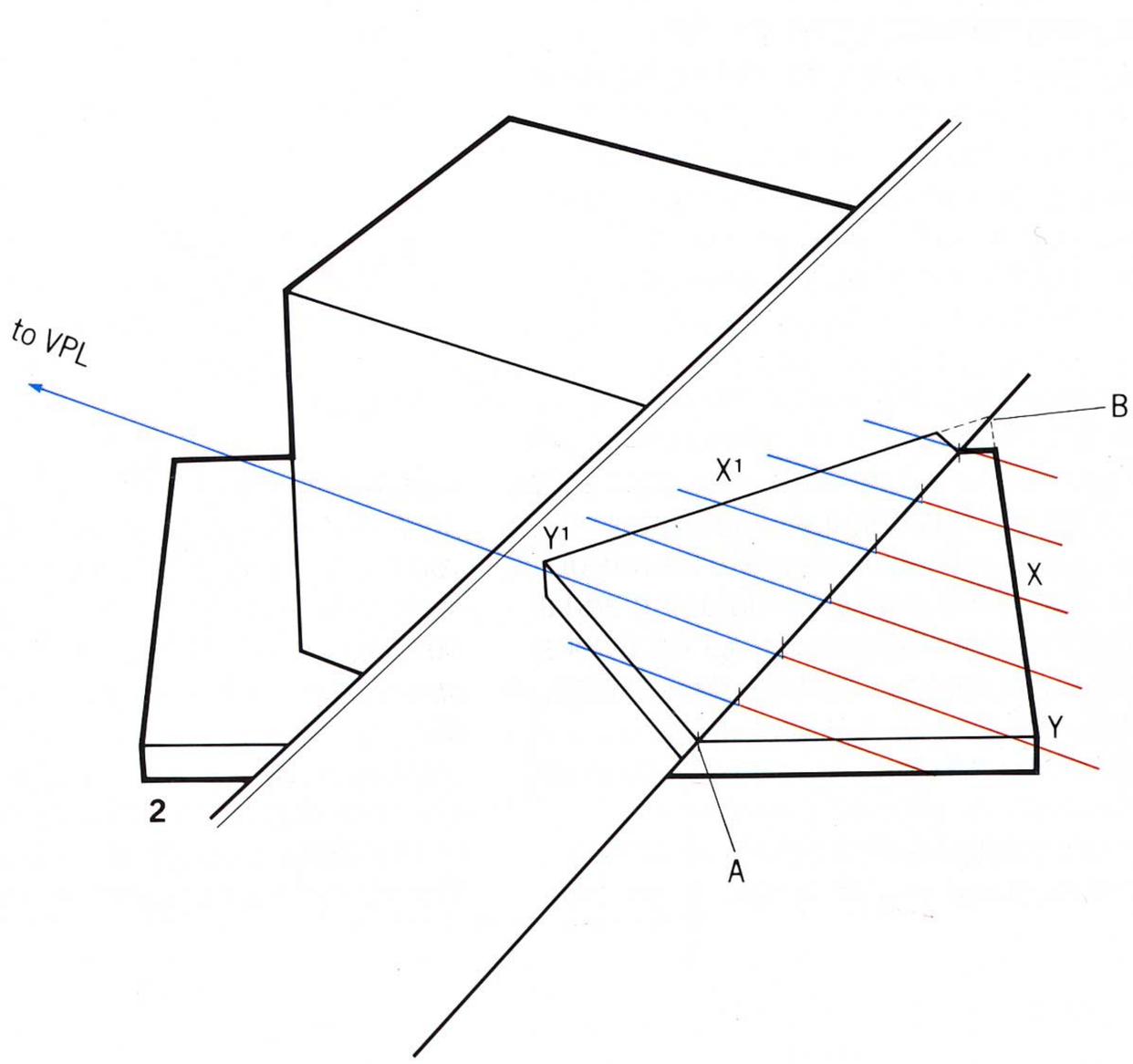


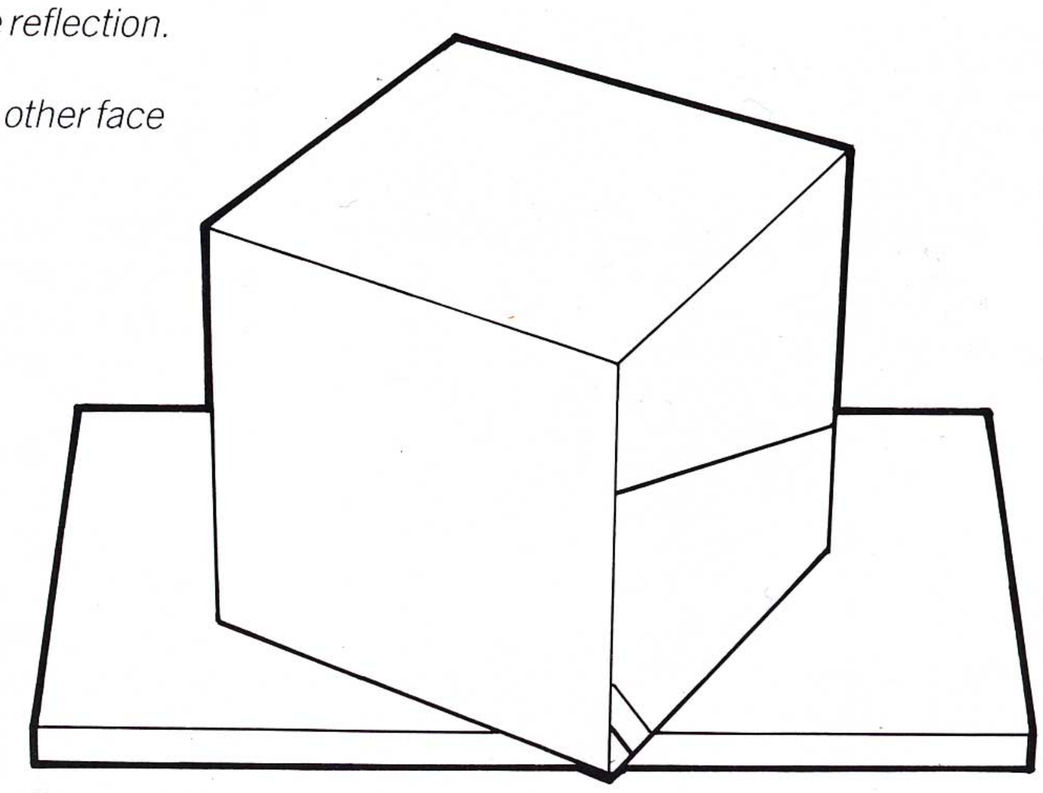
2

Constructing reflections (cont.)

3. Finally it only remains to reduce the mirror face back to its real size, rubbing out all extraneous lines in the process and just leaving the relevant part of the reflection.

4. Repeat the process for the other face of the cube.

5. Reduce the mirror face back to its original size, again eliminating unwanted construction lines.



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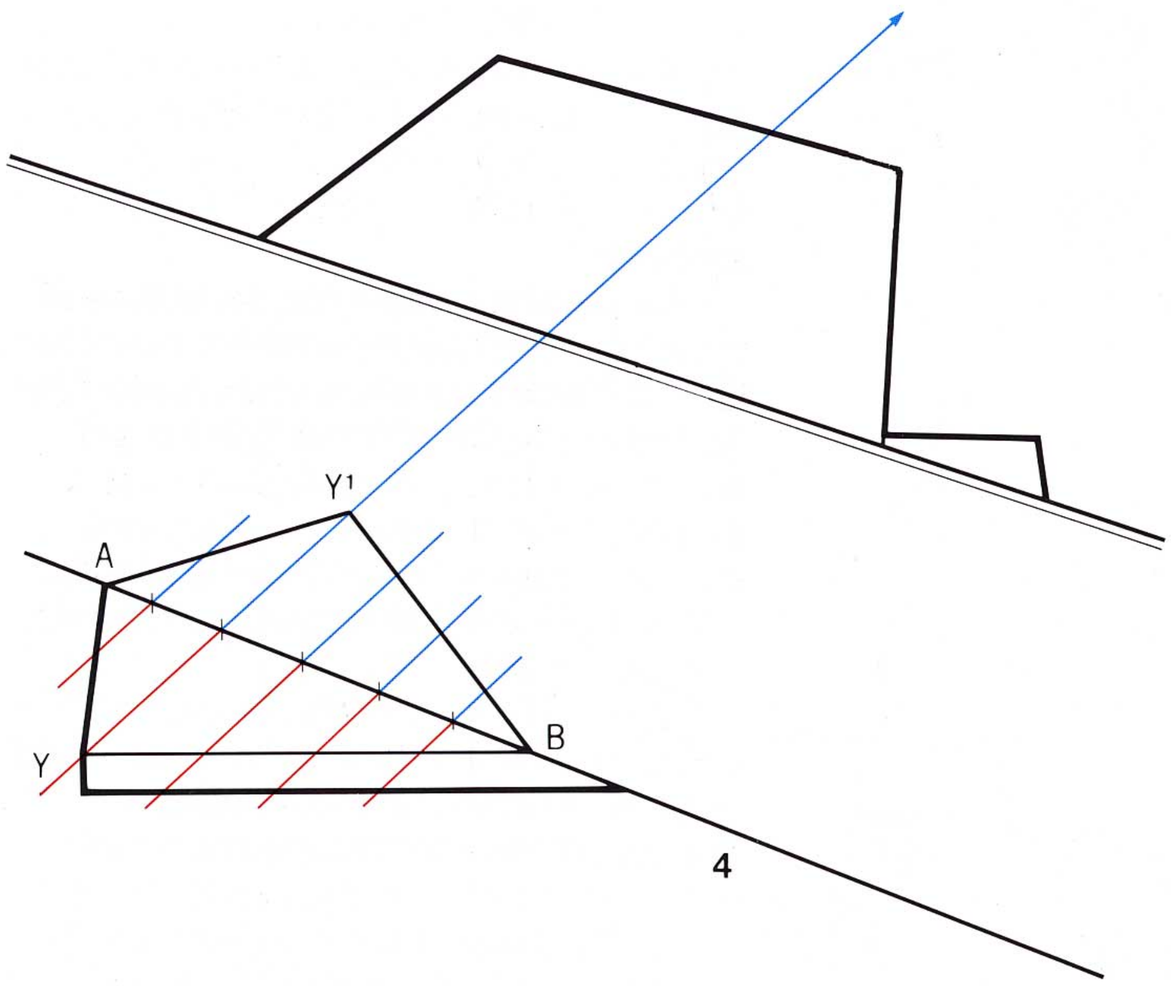

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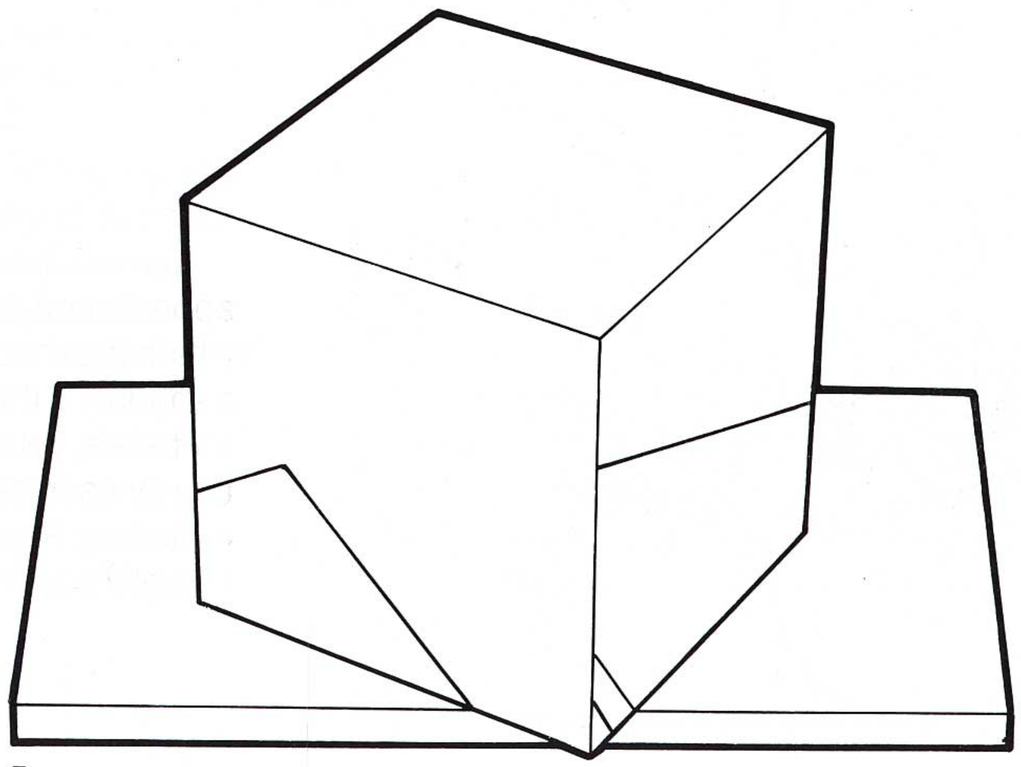


5

Remember that, provided the mirror face and surface being reflected are at right angles, then the reflected image shares the same vanishing points as the real image. Once the mirror face is rotated from the vertical, then the reflected image is also rotated in the same direction and all the construction lines should bend accordingly.

This basic technique can be easily used in two other clichés. The first is placing the product on a surface. Depending on the type of product, choose a surface that is easy to reflect. The most commonly used are tiled walls and floors but nearly any abstract pattern can be used to good effect. The second is using a part of the product itself. Rather than imagining the environment, or actually drawing a selected part of it, you may be able to use an element of the product itself to effect a bold reflection. For example control knobs, handles, folding covers or any moving parts may be positioned so that we see their reflection in adjoining surfaces. This allows us to choose the best possible reflection and to construct it as easily as possible.

The Window Cliché

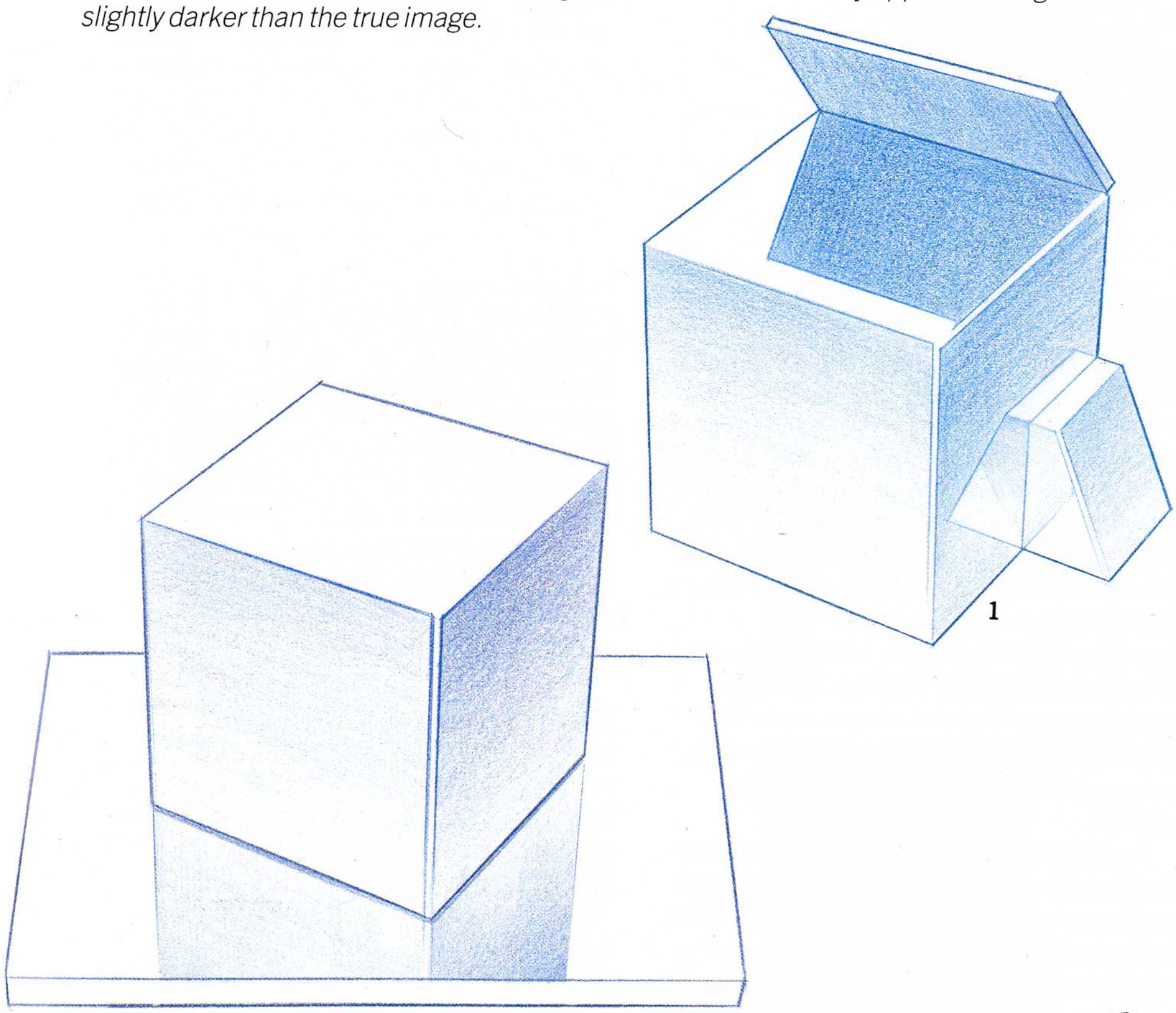
The window cliché is one of the most commonly used conventions to make surfaces look reflective. Cartoonists use it extensively, as do photographers when setting up product shots (although, of course, they simulate it by using a 'fish-fryer' light).

I use it most in horizontal surfaces. Nearly all windows are set in vertical walls and usually the wall in which the window is set is the darkest in the room; this provides the high contrast necessary for making things look glossy. Any horizontal surface, such as a table, or the top of our cube, will reflect the window as a high contrast *vertical* band (any line at right angles to the mirror surface will appear to pass through it). If the surface is slightly angled then the reflection will also be angled. You can therefore use the window reflection to indicate changing planes as, for example, in a record turntable top.

Below: Reflecting a part of the product
1. To make a surface look reflective it is often possible to position a part of the product so that its reflection can be seen in another part. In this example the open lid is reflected in the top of the cube and the shape on the side is reflected in that side. If the shape is itself reflective, then this will have a reflection of the cube in its side. As a general rule (and contrary to expectation) the reflected image is slightly darker than the true image.

2. It can be very effective to place the product on a surface or in an environment that reflects it – although this says more about the surface's finish than the product's.

Bottom: How highlights work
Highlights, or 'chings', are the reflections of bright light sources – the sun if outside, and lamps if inside. The areas in shadow are those areas diametrically opposite the light source.



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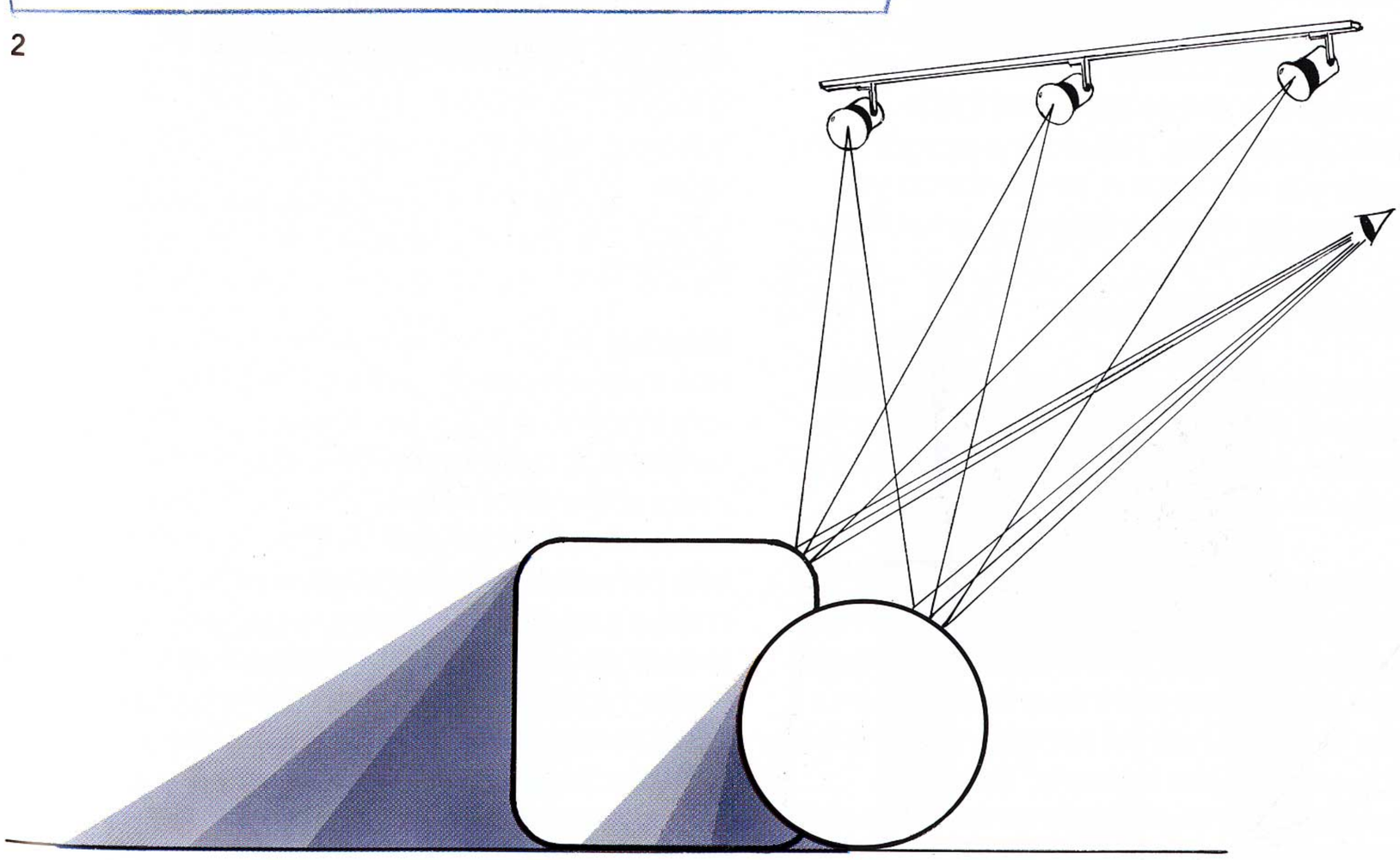

Highlights and Shadows

It is appropriate at this stage to return to the second basic approach outlined at the beginning of the chapter and imagine the product illuminated by a single light source. I usually position this almost directly over my head and to the left or right depending on which side of the product has most interest.

You can of course put the light source anywhere you choose, to obtain more dramatic effects, but once you do this you increase the shadowed part of the drawing considerably. Backlighting, for example, is difficult to do and throws the bulk of the product into shadow making it difficult to render (no highlights) and more difficult for the viewer to understand. Remember also that the focusing (or catch-all) effect of the radii that 'fall away', or point away, from the viewer are less pronounced, so that even the brightest, broadest light source behind will yield only a pencil-thin highlight on a falling-away edge. Highlights, sometimes called 'chings', are the reflections of the light source itself. In the case of an exterior view this would be the sun, and with an interior view will probably be a single spotlight or track of spotlights.

When putting in highlights, do not think of the light as coming from anywhere, but rather think of it in terms of where on the product the light source will be reflected. With the light source, whether sun or spotlight, almost directly over your head and slightly to one side, all the near edges and curves will catch the highlight, and their focusing effect will be at its most pronounced.

It is also, of course, the light source which determines the disposition of shadows, so it is convenient to consider the two effects together. With the light source above and behind the viewer, the shadows are thrown behind and below the product, so that they have an absolutely minimal effect on the ground or base. Where they do become crucial is when the product has a part (or parts) throwing a shadow across itself. In this case it is nearly always essential to put in the shadow and it is usually not difficult to estimate its position.

Remember that the colour of the shadow appears as a dark tone of the material on which the shadow is cast. This means that, if a shadow is thrown across two different materials, you should change the colour you use for each part as it passes across the two materials. Remember also that there is virtually no shadow on chrome.