Mirror Images

Georg Maier

The following article is excerpted from Chapter 3 of An Optics of Visual Experience*, by Georg Maier. The text has been abridged and adapted for* In Context. *See the box on next page and the end of the article for further information.*

When we see a rock in the landscape we feel sure that it is "really there!" Seeing is usually experienced almost like touching. Sight helps us to orient ourselves in our surroundings when we set off toward an as yet distant goal, just as it lets us attend to our activities right here where we are. Thus seeing is generally thought to simply be our ability to keep an eye on objects.

Any attempt to use mirror images to orient ourselves in a similar way will lead to confusion. They do not seem to correspond to our other perceptions of bodies with respect to their location. They offer "extra," "indirect" views, and as long as we are not clear about what we mean here by "indirect," we will justifiably claim that they are unreal for us.

In the following considerations the object that is mirrored will be referred to as the prototype. Our main task will be to understand the lawful relationships between mirror images and their prototypes.

Mirror Images in a Quiet Pond

It is worthwhile to study reflections in quite some detail in a moderately-sized pond. Memorable key experiences can be gained in such a situation. If the pond is small and sheltered from wind, its surface will normally be quiet. We need this quiet for the time being, until we are ready to deal with the glistening, quivering, and confusing array of stretching and shrinking images—the visible motion of the water's surface.

One of the first impressions of reflections in a pond might be the unfamiliar sight of brightness shining up from below. The colors of the sky and the clouds, or the shining of the sun are repeated, though somewhat dulled, in the depths below. In fact, the water does not need to be deep in order to give a "deep-reaching" mirror image. We can often notice the remarkable repetition of forms, by which the images seen in the water adjoin the surrounding scenery. At the far bank there may be reeds. Their mirror image continues directly downward. The mirror images below and the sources of the images above show remarkable similarity. Many details of the images below can be found above as well. Are these two classes of images the same? Or better: What are their differences?

Does the mirror image have any *reality*? If we stick our head under water, the mirror image disappears. What we perceived in the water as mirror image cannot be found there as a tangible object. All we find there is wetness. But are only those things real that can be grasped or at least touched? As we deal with mirror images, we are reminded that everything visual is given in images, which consist of intangible brightness, darkness, and colors. Certainly a mirror image is real enough that we can encounter something new within it, something with which we can grapple, something which we can attempt to understand.

Distinctness. Not everything is mirrored as clearly as the plants on the opposite bank of the pond. If we step up to the water's edge, we can look straight down. In this case the mirror image is rather like a delicate veil lying over the view into the water. In this respect it resembles shadows. These, too, superimpose themselves over the forms and colors of a scene. As we move back from the bank, the pale, translucent mirror image gains strength. The further we look out, the clearer the image becomes—and at the far bank the mirror image and that which is mirrored fuse into one another. As we squat down and our eyes are brought closer and closer to the water's surface, the mirror image is pulled toward us across the surface of the pond. As we shall see, the mirror image thereby becomes more and more symmetrical to what we perceive directly above the water on the far side of the pond.

An Invitation to Look

It is a remarkable fact, in the words of physicist Martin Wagenschein, that "physical acoustics only contains what remains of sound, and of music, for someone who is deaf." Similarly, in a conventional physics-based understanding of a tree, for example, "some of its structure and geometry remain, but color, smell, three-dimensionality, and the rustling of its leaves are missing" (http://natureinstitute.org/txt/mw/save_phenomena.htm).

Not so in Georg Maier's phenomenological physics. He wants us to turn to the phenomenal world, perceive it carefully and wakefully in its variations and relations, and take what thus appears seriously as part of reality. Maier's physics is a call to enter with openness into the concrete phenomena and to hold back with all our tendencies to transcend experience in favor of conceptual abstractions and models. The insights that arise are subtle and deep.

In this excerpt from his *An Optics of Visual Experience*, Maier leads us into phenomena related to mirroring—images we see through a pond's quiet surface or in a mirror hanging on a wall. He calls the reader's attention to seemingly simple phenomena and their relations to one another. By moving carefully from observation to observation—and we need to make those observations ourselves—he shows how a world reveals itself when we take the time and care to actually observe what can be seen but is so easily overlooked. Maier's work is an invitation to perceive the appearances of the world. In this excerpt we get to know mirror images not as "mere reflections" of a more real world of "actual things," but rather as a coherent realm of phenomena that has its own special qualities. When—to use an example from the text—an upright stick is placed between a burning candle and a mirror, the images of both, along with the shadow that the stick casts, can be seen in the mirror. But that is not all, the mirror image of the candle is also a source of illumination and the mirror image of the stick now casts a shadow out into the space in front of the mirror! This is utterly surprising and leads us to recognize that "mirror space," as Maier calls it, has its own efficacy. It is not a space that we can enter with our bodies, but as a visually experienced space it does have effects on the space we live in as embodied beings.

An Optics of Visual Experience is not an easy read since it only points to what we readers need to discover for ourselves. Used as a guide to careful and systematic study it can open us to phenomena—of illumination, shadows, reflection, and much more—that are part of the structure and dynamics of the visual world we live in but that we are not normally aware of. The result of the effort is a wakeful awareness of being part of a richly nuanced and deep world.

Maier earned a Ph.D. in physics in 1960, and then spent about seven years doing nuclear-based research, particularly in the field of neutron optics. As he writes,

> I entered a profession with its own specific approach to the world — a profession requiring intelligence and a talent for inventing logically well-formed connections between abstract ideas. Only gradually did I become more open to present appearance, learning to trust it right into the sphere of personal decisions. If at first I had to devote myself fully to abstraction, it was in order to develop later a contrasting appreciation for the specific and unique appearance. (*Being On Earth,* Chapter 5, p.1; http://natureinstitute.org/txt/gm/boe)

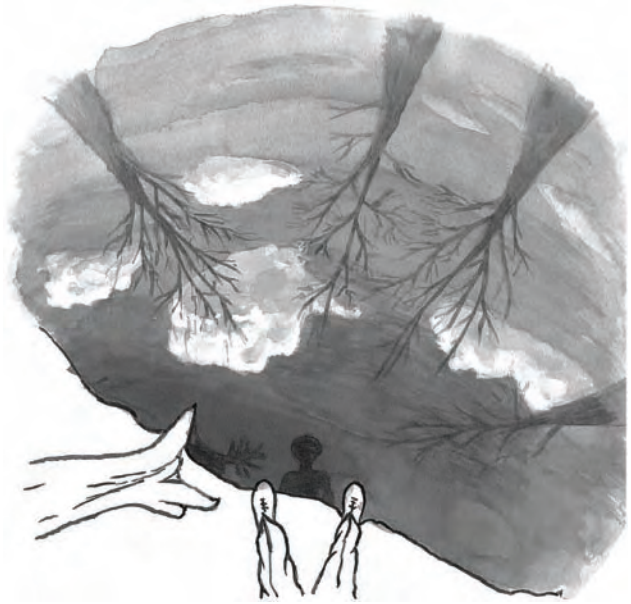
From 1969 to 1998 he worked at the Research Institute of the Goetheanum in Dornach, Switzerland, pursuing phenomenological, experience-based physics. Now retired, he continues his researches in Dornach, where he lives. *In Context* readers can learn more about Georg Maier and his approach to science in *Being on Earth*, which Maier wrote together with his colleagues Stephen Edelglass and Ron Brady (http://natureinstitute.org/txt/gm/boe).

Craig Holdrege

Mirror Space

There are two extreme types of reflections: Glancing reflections, for example those of the irises on the opposite bank, are such that mirror image and prototype meet one another directly and become a pair. The mirror image appears as a folded-down repetition of the prototype.

However, if we look at the mirroring surface straight on, that is, at a right angle, we see only images for which there are no corresponding prototypes in our direct view. Our own countenance appears as a mirror image. When we look down to the edge of the bank, we see prototypes that show us their one side while they expose their other side to the mirroring surface. [As a result, if there is a low, bushy plant near our feet, we look *directly* at the upper surfaces of the leaves, but in the reflected image we see the undersides of the leaves—ed.] In the background close to the image of our face we see mirror images of prototypes which are currently behind (or above) us, and are thus hidden from our direct view. In this way the perpendicular view toward the mirror separates mirror image and prototype, while they appear together as twins in glancing reflection.



What points upward in the prototypes (such as a tree) points downward in the mirror image. This reversal is particularly impressive when there are many upright lines in the mirrored scenery. Imagine standing at the edge of a pond in the woods. Now lean forward and look at your own mirror image below. From all around, the mirror images of the surrounding trees are pointing like spokes toward a center—and this center is the mirror image of your own face. Looking down with one eye, you see the mirror image of this same eye exactly below it. With your head looking down and your body bent over, you see a sight which would otherwise only be given in the exceptional view of facing yourself from underneath and looking *straight up*. The direction toward the zenith is marked by the mirror image of your eye, and all vertical tree trunks are pointing in this direction.

Between these two extremes (glancing reflection and perpendicular view into the mirror) a new aspect is added to the direct view of an object. If the direct view is a side view, for example, then the mirror image shows us a view of the object which could only be given from comparatively further below. By offering a new, second view, the mirror image facilitates a *spatial understanding* of the situation at hand.

The mirror image seen in the pond is not a fixed pattern on the water surface. With every movement we make, the image changes. Here in the realm of mirror images we are dealing with proximity and distance. As we look down into the mirror image, we are looking *through* the water's surface into a *space* underneath it. All the laws of vision in three dimensions can be found to apply in this space! As we walk along the shore of the pond or lake, the direction of our view into this *mirror space* changes, just as it does in the space of direct vision we are accustomed to. In mirror space, too, unmoving things remain in their proper place, and while we ourselves move about in our space up here, down in mirror space new views of them arise constantly in familiar fashion. The space down below is inexorably connected with our space up here, the water surface serving as an invisible seam between both spaces. The question is only: What is the spatial arrangement of the things below the surface of the water? This refers, of course, to things *seen* in the mirror space "behind the surface of the water," not to tangible things in the water. In all the descriptions here it is tacitly assumed that there is no wind, and no insects or fishes to disturb the quiet and unmoving water surface.

We see our own eye vertically below ourselves when we look into the water. Other people looking at us from elsewhere around the pond see our form not only directly but also a second time in the space below, but there it is standing on its head, reversed, or, in other words, *mirrored*. In terms of spatial measure this means that our mirror image appears to be just as far below the water surface as we appear to be above it. In fact the entire mirror space below is structured according to this principle as the visual world continues below the plane of reflection. Thus, both spaces are totally symmetrical in relation to the mirror plane.

While the spaces *themselves* are symmetrical, the fact that we are situated in prototype space leads to an asymmetry between our view down into mirror space and the direct view we have of the scene in prototype space. This asymmetry has been taken

into account by artists who developed landscape painting. While their paintings still show errors in the rendering of perspective, they obviously attempted to reproduce spatial relationships on their canvasses. Let us look at the painting of Saint Christopher by *Konrad Witz*, painted around 1435. We will occupy ourselves with his rendering of the scenery on the far shore and its reflection. To facilitate this, the outlines of several objects and their mirror images have been highlighted in outline. Near the water we see a monk. Behind him is a chapel, and the tip of its steeple is in front of the steep hill. All of this is also depicted by the artist in the mirror image, albeit distorted. But why does he show the tip of the reflected steeple as reaching above the outline of the hill? Did we not notice in the direct view that the chapel is actually not that far up? And where is the cliff with the jagged crown?

Well, the artist has depicted this quite correctly. The painter's position is *above the seam* between the upper world and the mirrored world. Because of his elevation above the water, his direct view of the landscape across from him will differ from the mirror image of that landscape, which appears as seen from a different perspective. To better understand this, let us compare the relationship of foreground and background above and below the water's surface as we bend down and lower our head closer and closer to the mirroring plane:

In the direct view, the higher our position, the more the background appears raised up in relation to the foreground: The hillside appears higher than the steeple, as is the case in the direct view in the painting. As we bend down, the background of course *moves along with us*. It descends in relation to the foreground, and the steeple begins to rise above the hillside.

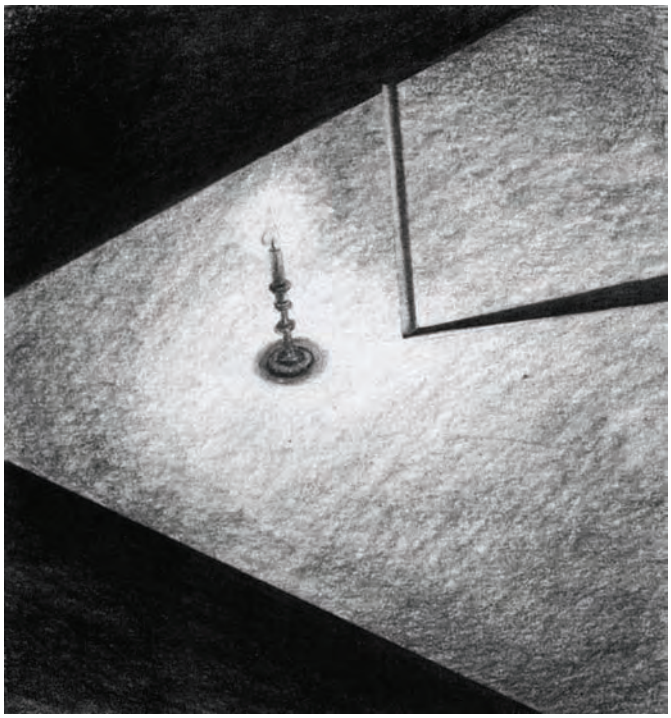
Now, what happens in the mirror image? We have just seen that, as we rise in the upper space, the background rises with us in our direct view of the scene. At the same time, however, our perspective into the lower space becomes equivalent to a "view from the depths," whereby objects directly on the shore are seen raised up against the sky. From our raised position, therefore, the steeple in the mirror image extends above the hillside as is correctly shown in the painting. As we bend down, however, the background of the mirror image rises up in relation to the foreground. The result is that, as we approach the mirror plane, the views into both spaces become more and more similar, and hence the mirror image looks more and more like the direct view.

We can state this in a different way: Our view into mirror space must be exactly the same view of the landscape that the fellow we see below us (our own mirror image, that is) would see when looking up into prototype space from his position down there.

The view seen by the "person in the depths" is indicated when we turn *Claude Monet's* picture, "The Painter's Boat," upside down and observe the mirror image of the boat: this mirror image shows us the boat as it would look when seen from below.

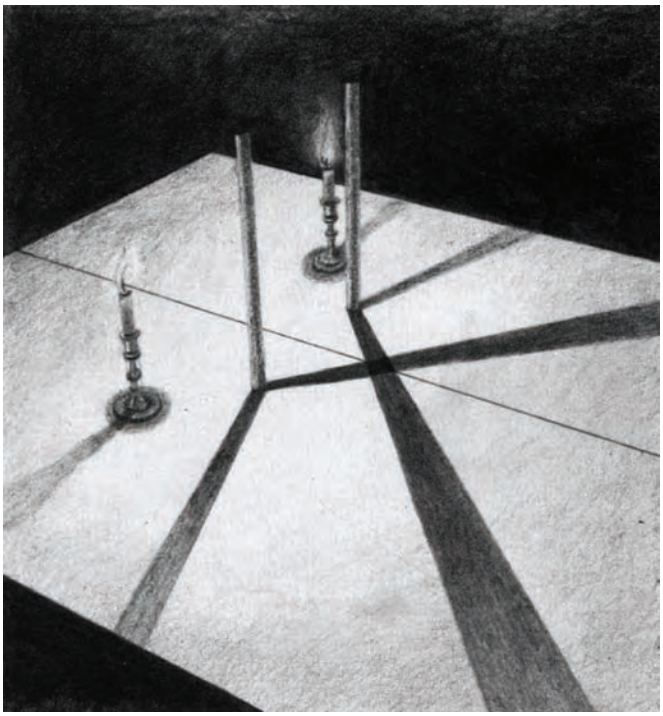
Mirror Space as an Optically Real Continuation of Space

All plane mirrors offer a view into a mirrored space. The mirror plane is the invisible seam between the two spaces. By using solid metallic mirrors, we can move the mirror plane out of the horizontal (the orientation of the water in the pond) and make it vertical, for example by hanging a mirror on a wall. Even a small mirror acts like a window into an adjacent room. The frame of this window limits our field of vision; however we can move around in front of the "opening" and survey the width and breadth of the "room next door."



So far we have dealt only with the view into mirror space. How shining and shadow are mirrored is nicely demonstrated by the following experiment devised by Fritz Julius:

On a table with a white surface stands a candle in a candlestick in an otherwise dark room. Beside it stands an opaque column which casts a shadow (see upper figure). Behind both we place a vertical surface covered by a white cloth (not shown). The shadow of the column will be cast both on the table, as in the figure, and also on the cloth. When the cloth is removed, we see that it was covering a mirror, as in the illustration below. Now let us first try to imagine what we would *expect* to see when the cloth has been removed. One might assume that the mirror would show the mirror image of the scene we saw before the cloth had been taken away: the mirror would simply reproduce what is in front of it, the candle and the column would be mirrored, and a single shadow would reach from both the column and its mirrored image just up to the mirror plane. But in reality quite a different scene appears: all the shadows appear that can be created by *both* visible candle flames as they shine on the two columns and on the candles themselves. These shadows just continue from the space in front of the mirror into the space behind it. Where the shadows cross, a particularly dark area arises. For this area, both flames are hidden by the two shadow-casting columns.



A light in mirror space is indeed optically effective. It illuminates both spaces. In the same way, opaque objects in mirror space are just as effective in casting shadows as their prototypes in front of the mirror. They can cast shadows that extend into the space in front of the mirror, just as those in prototype space cast shadows into mirror space.

The action of the plane mirror is rendered completely understandable by applying the concept of *mirror space*. Mirror space is a direct, immediate summary of the relevant empirical experience. We can see it with our eyes. We have also convinced ourselves that mirror space is optically real, even though it depends on the conditions of the reflecting plane.

An Optics of Visual Experience *(forthcoming in 2011) will be available from Adonis Press, 321 Rodman Road, Hillsdale, New York 12529; tel. 518-325-1100; http://www.adonispress.org. The book is softcover, 232 pages, and costs $35. Translated from the German by Henry Saphir and John Barnes.*