

Light and Objects

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An Entryway to Optics

This short essay is about nothing other than physics, or, if you will, an entryway to physics. Such an entry is, however, important because it isn't "just an entryway." As a preliminary stage to physics it is as important as the root is to the tree. We usually tend to forget this stage in our teaching. We must pass through this entryway and experience it both silently and as a preliminary form of thinking. Only then will we be able to understand the pressed and dried forms that comprise the herbarium of a textbook. (Where one finds phrases such as "Light is produced by rays emanating from bodies. We distinguish between light sources and dark bodies, which only become visible..." and so forth.) Passing through the entryway allows us to derive these abstracted formulations in a way that illuminates the experiential elements they contain.

It is very easy to make space for this step in teaching. You prepare the situation: a dark room, an illuminating projector, and dust. The group of children will eagerly throng around this miracle—and then do not speak, let the children speak. They will experience something like what is described in the section below. Afterwards, their experiences can easily be brought into a certain order and—with the teacher as catalyzer—crystallized. When the children then proceed to write down what they have experienced, they will have what they need. No matter how exact his scientific knowledge, a teacher who aspires to bring physics to children must make every effort to remain capable (or become capable again) of stepping back into this entryway.

Sunbeams

When he awoke, the sun shone on his bed. He shook out the blanket, leaned back, and looked into the world of little sunny specks of dust he had whirled up. He had to think of Lichtenberg's words: "What glitters there so beautifully in the sun is in fact nothing but specks of dirt." Their shining dance against the background of the dark cupboard reminded him of the movements of shoals of excited fish. Little by little they quieted down as they gradually descended, more in concert now. He was amazed how slowly. Many of them flickered in settling down, alternatively shining bright and extinguishing. He also remembered how leaves often turn as they fall, showing a shiny flat side one moment, an inconspicuous edge the next.

These dust particles thus revealed their form as little flakes, without showing their exact outline. By and by he noticed less the individual little stars themselves, and all the more the cloud they formed as a whole, even though he could not distinguish its boundaries. Once again he beat the blanket and chased the swirling dust particles out of the brightness into the darkness where they disappeared. From other places new particles streamed back into the choice zone, where grey dust turned into silver stars. The whole room had to be full of these floating particles, but they could only shine in the beam of light, which stood stiff in the room, indifferent somehow while they played through it. They were not exactly free, but followed their prescribed paths gracefully in two patterns: the particles streamed fanlike or swirled within the ever newly created current, but then they followed the monotonous and common necessity of falling. But the light beam stood unmoved.

All this lasted only as long as the sun was shining. A cloud intervened, and everything was

extinguished. The stiff beam and the swirling stars, they both had to disappear, because they were not two separate things. He saw that now. Without the light beam you couldn't see the dust specks, and without the little stars there was no light beam. So that is how the light is, he said to himself. By itself you cannot see it, only through the objects. And the objects themselves are invisible unless you see them in light.

phrasing is highly original and pictorial. We have done our best to capture some of this spirit in the translation.

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ADDENDUM: What is a Phenomenon?

A former university student wrote the following description about Wagenschein's approach:

As far as I have been able to understand it, a phenomenon comprises both what we see and observe and what subsequently causes astonishment, reflection, and thought. So something outer (an observation) and inner (a thought) come together and are then so to speak one thing, one phenomenon. For Wagenschein both things (the inner and the outer) belong together and are interdependent. The knowledge one gains in thinking about a phenomenon is part of the phenomenon. It all belongs together. The example of the light beams, which one suddenly gets to see while thousands of little specks of dust fly through the air, making the light scintillate, I found very impressive and I immediately understood why this fascinating interplay is a phenomenon in the way Wagenschein understood it.

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The original German essay is entitled "Das Licht und die Dinge" and was first published in 1952. The essay and the addendum were printed in *Einwurzelung und Verdichtung* by Peter Buck (Dürnau, Germany: Kooperative Dürnau, 1997, pp. 43–46), which is the source of this translation by Jan Kees Saltet and Craig Holdrege; the translation has been approved by Wagenschein's literary heirs. Wagenschein always selected his words very carefully, and his choice of words and