known as kinematics. Now kinematics is actually also something quite distant from the "real" natural phenomenon. You see, rather than looking at a moving object, I imagine the movement. I imagine that an object moves from, say, point *a* to point *b* [Figure 1a]. I even say that point *a* moves toward point *b*. I imagine it. I can also imagine this movement from *a* to *b* to be composed of two movements. Imagine for a moment that point *a* came to point *b*, but that it did not immediately move directly to point *b*. Instead it moved first to *c*. If it subsequently moves from *c* to *b*, it also arrives at *b*. Thus I can also imagine the movement from *a* to *b* such that it does not take place on the line *a-b*, but on the line or on the two lines *a-c-b*. That means I can imagine that the movement *a-b* is composed of *a-c* and *c-b*, in other words of two other movements. You do not have to observe a natural event at all. You can simply imagine that movement *a-b* is composed of the two other movements. That is, instead of one movement, two movements can be carried out with the same effect. Now, if I imagine this, it is a pure construct because, instead of drawing it, I could have given you instructions for visualizing the situation, and that would have to be a valid concept for you.

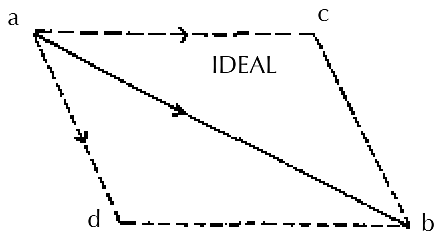


Figure 1a

However, if there really is such a thing in nature as point *a*, for example a single grain of shot, and it moves first from *a* to *b*, and another time from *a* to *c* and then from *c* to *b*, then what I have imagined really takes place. In other words, in kinematics

I imagine the movements, but for this concept to be applicable to natural phenomena it must hold for the natural phenomena themselves.

Thus we can say that in arithmetic, geometry, and kinematics we have three preliminary stages of the study of nature. The concepts we gain from them are pure constructs, but they are authoritative for what happens in nature.

Now I would like you to take a little walk down memory lane into your more or less distant study of physics and recall that you were once confronted with something called the parallelogram of forces [Figure 1b]: if a force acts on point *a*, this force can pull point *a* to point *b*. Now, by point *a* I mean something material—let's say a tiny grain. I pull it from *a* to *b* by means of a force. Please note the difference between what I am saying now and what I said before. Before I spoke of the movement. Now I am saying that a force pulls *a* toward *b*. If you express in line segments the measurement of the force, say five grams, that pulls from *a* to *b* (see illustration)—one gram, two grams, three grams, four grams, five grams—then you can say, I am pulling *a* to *b* with a force of five grams.

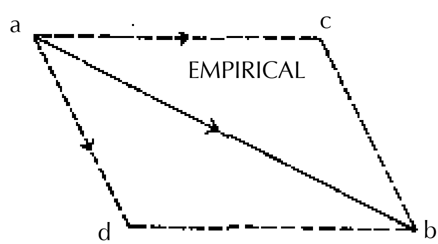


Figure 1b

I could also arrange the whole process differently. I could first pull *a* to *c* with a given force, but, if I pull it from *a* to *c*, then I can still carry out a second pull. I can pull in the direction indicated here by the line connecting *c* to *b*, and then I begin with the assumption that this force acts continuously. In other words, the force acts on the point along its entire path. And let's call the distance along which this force acts on the point d. We also have to take into account the fact that the point must be something in space, and this *something* can be larger or smaller. Depending on whether this *something* is larger or smaller we can say that the point has a greater or smaller mass. For the moment we will express the mass in terms of weight. We can weigh what the force moves and express it in terms of weight. Let's then call the mass m.

Of course, if force F acts on mass m, a certain effect must take place. This does not manifest itself in the mass's having a constant velocity, but rather in its moving faster and faster. The velocity becomes greater and greater. In other words, we have to take into account that we are dealing with an increasing velocity. A smaller force acting on the same mass will be able to effect a smaller increase in velocity, while a larger force acting on the same mass will be able to effect a larger increase in velocity. Let's call this measure of the increase in velocity the acceleration and indicate it by the symbol a. And here I want to remind you of a formula that you probably already know, but should recall, for what interests us above all is the following: If you multiply the force that acts on the mass by the distance, you get a product equal to—that is, it can be expressed by—the mass multiplied by the square of the velocity divided by two. That is,

$$Fd = \frac{mv^2}{2}$$

Looking at the equation, you see that the mass is on the right side. You can gather from the equation that the bigger the mass is, the more force is required. However, what interests us now is that we have mass on the right side of the equation—the thing we can never arrive at through kinematics. Should we

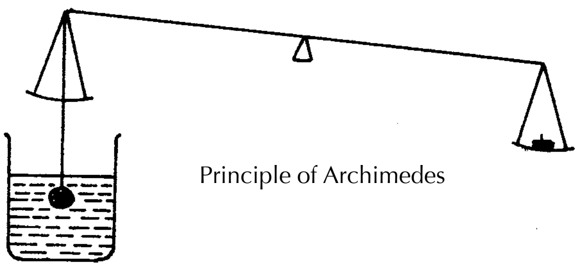


Figure 2a

On the average the human brain weighs 1250 grams. If the brain were actually to weigh 1250 grams when we carry it in ourselves, then it would press down so strongly on the blood vessels under it that it could no longer be properly supplied with blood. A heavy pressure would be exerted, which would instantly cloud our consciousness. In reality the brain doesn't press down on the base of the skull cavity with its full 1250 grams at all, but only with 20 grams. That is because the brain floats in the cerebrospinal fluid. Just as this body here floats in the water, the brain floats in the cerebrospinal fluid. And the weight of the cerebrospinal fluid that is displaced by the brain is equal to approximately 1230 grams. The brain becomes that much lighter and then weighs only 20 grams. That means that if we regard the brain as the tool of our intelligence and of our soul life, at least of a part of our soul life—as we indeed do with a certain amount of justification—then we should not be thinking only in terms of the weighable brain. For that is not the only thing there. Rather, by means of this buoyancy, the brain actually strives upward—strives upward against its own weight. That means that with our intelligence we do not live in forces that pull us downward, but rather in forces that pull us upward. With our intelligence we live in a state of buoyancy.

from simply reaching the facing wall and creating a circle there. Instead it is forced to deviate from its path. We cause that to happen by using a hollow prism, which is put together such that we have glass panes arranged in a wedge [Figure 2c]. This hollow prism is filled with water. We let the light beam created here pass through this water prism. Now if you look at the wall, you see that the disk of light is not at the same place down here where it was before. Instead, you see that it is raised—it appears at a different place. Besides that, you notice something else remarkable. Above, you see the edge in a bluish-green light, with a bluish-green edge, a bluish edge. Below, you see a reddish-yellow edge.

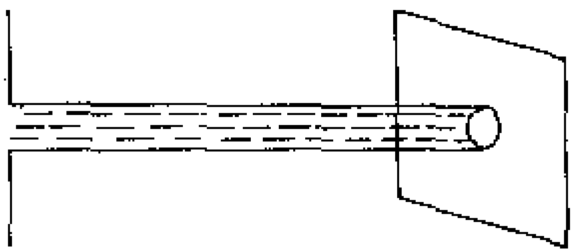


Figure 2b

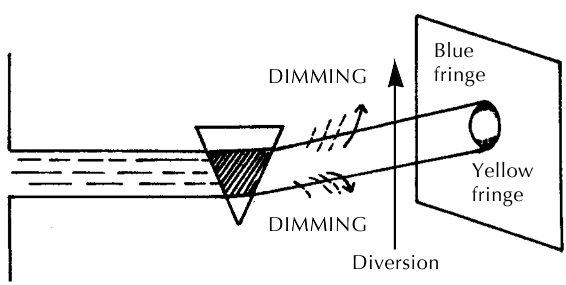


Figure 2c

There we have what we call a phenomenon. Let's hold on to this phenomenon for a moment. If we note down the facts, we have to note them thus: Somehow the light deviates from image that was more extended lengthwise, but at the same time this more extended light image would turn out to be very indistinct and dark. This is understandable when, by capturing this image on a screen, I get a reproduction of the circle of light that is pushed into itself. But I could also move the screen in. Once again I would get a reproduction. In other words, there would be a distance—all of this remains within the facts—within which I would always find it possible to get a reproduction. You can conclude that we are manipulating the light by means of the double prism. Outside I will always find a red edge, in fact at both the top and the bottom, and violet in the middle. While otherwise I got only an image from red to violet, now I get red on the outer edges and violet in the middle, with the other colors in between. Thus with such a double prism I could make it possible for such a figure to emerge. However, I would also get this figure if I moved the screen. Therefore I have a certain distance within which it is possible for an image to appear that has color on the edges, but also has color in the middle and all sorts of transitional colors.

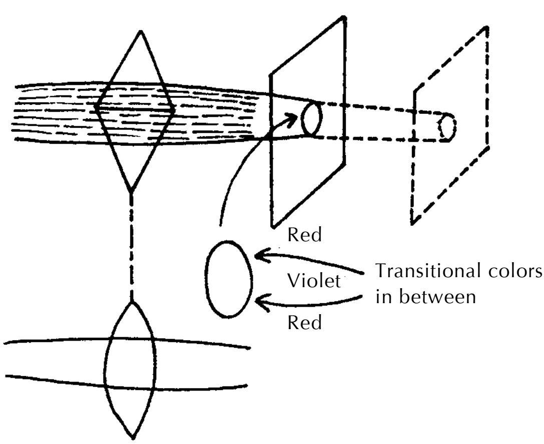


Figure 3a

course, then I would get the same description I made before, but with a considerably enlarged circle. Once again, by walking up and down with the screen, I would have the possibility of getting a more or less distinct image within a certain distance. In this case I would have violet and bluish color above and also below, and in the middle I would have red. Before it was reversed. And in between are the intermediate colors.

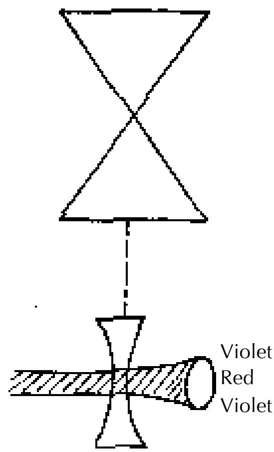


Figure 3b

Once again I can replace this double prism with a lens having this cross section [Figure 3b]. This lens [Figure 3a] is thick in the cross section across the middle and thin at the edges. And this lens [Figure 3b] is thin in the middle and thick at the edges: in this case I get an enlarged image, which is significantly larger than the normal cross section that would emerge from the beam of light. I get an enlarged image, but also with the gradation of colors on the edges and toward the middle. Thus if I want to investigate these phenomena, I have to say that the beam of light has been expanded—it has essentially been driven apart. That is a simple fact.

Now I begin to draw: a ray of light starts out from this object, is sent into the eye, and affects the eye—and then I fantasize all sorts of possible things about it.

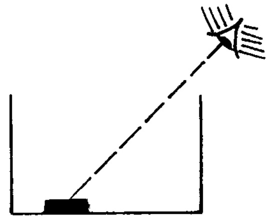


Figure 3c

Now I fill the container up to here with water or any other liquid [Figure 3d]. And something quite special happens. I trace the same direction from the eye to the object in which I saw the object before, and look in that direction. I could expect to see the same thing, but I don't. Instead, something highly peculiar occurs: I see the object a bit raised.[3] I see it in such a way that it is raised along with the entire bottom of the container. Of course, we can talk about how we can determine that, I mean measure it, later. Right now, I just want to talk about the principles. What could be the basis of this, if I am going to answer the question about the facts of the matter?

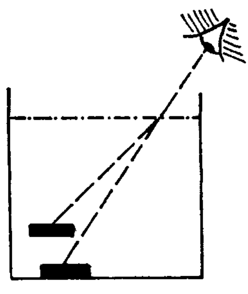


Figure 3d

Now I expect to find the object in the same direction in which I looked earlier. I direct my eye toward it, but I don't see it in that direction. I see it in another direction. Of course, before, when there was no water in the container and only air between my eye and the bottom, I was able to look down directly to the bottom. Now my line of sight collides with the water here, which doesn't let my eyesight through so easily as the air; it offers greater resistance, and I have to shy away from the greater resistance. From this point on I have to shy away from the greater resistance. This shying away is expressed in the fact that I don't see to the bottom, but that instead the whole thing appears to be raised. I see with more difficulty, so to speak, through the water than through the air. It is harder for me to overcome the resistance of the water than that of the air, so I have to shorten the force, thus pulling the object itself upward. I shorten the force in meeting a stronger resistance. If I were able to fill this with a gas that was thinner than air, the object would sink, because then I would meet less resistance. Thus I would push the object downward [Figure 3e].

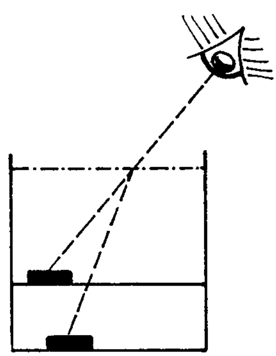


Figure 3e

Physicists don't state the facts of the matter in this way. Instead they say that a ray of light is thrown onto the surface of the water. The ray of light is bent there; because a transition become kinematics, how they don't want to go into qualities. On the one hand, they divest the eye of any kind of activity; on the other hand, the eye projects outward the stimulus it receives. What is necessary, however, is that we begin at the outset with the activity of the eye, that we be clear that the eye is an active organism.

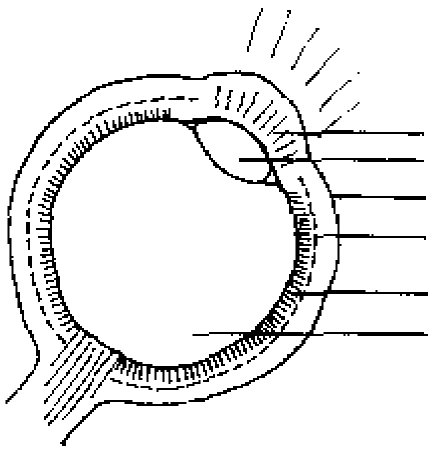
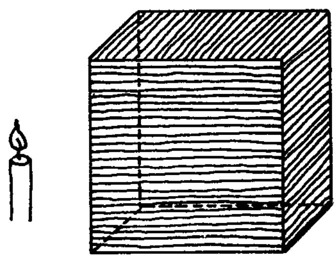


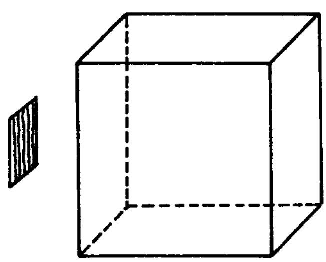
Figure 3f

Now you see we have a model of the eye, and today we will also begin to deal with the nature of the human eye. The eye is of course a ball of sorts, just compressed a bit from front to back, a ball that sits here in the bone socket in such a way that first a series of skins surround the inner part of the eye. If I want to draw the cross section, I would have to do it like this [Figure 3f]—what I'm drawing now would be the right eye. If we were to take the eye out of the skull and dissect it, the outermost part, which we would find first, would be connective tissue, fat. But then we come to the first actual covering of the eye, the so-called sclera and cornea. This outermost covering is sinewy, bony, and cartilaginous. I've drawn it in here. It however, that I have a trough of water here, and I shoot light through it so that it is illuminated. Then I have an illuminated liquid here, and I see the darkness through the brightness. I see it through something illuminated. Then blue or violet (purple) appears—in other words, the other pole of color [Figure 4b]. That is the archetypal phenomenon: brightness through darkness—yellow; darkness through brightness—blue.



Light through dark ... reddish yellow

Figure 4a



Dark through something illuminated ... blue-violet

Figure 4b

This simple phenomenon can be seen everywhere if we just get used to thinking concretely instead of abstractly, the way modern science thinks. With this in mind, recall the experiment we already conducted, where we let a beam of light pass through a prism and thereby got a true spectrum of colors from violet to red, which we captured. I have already sketched this

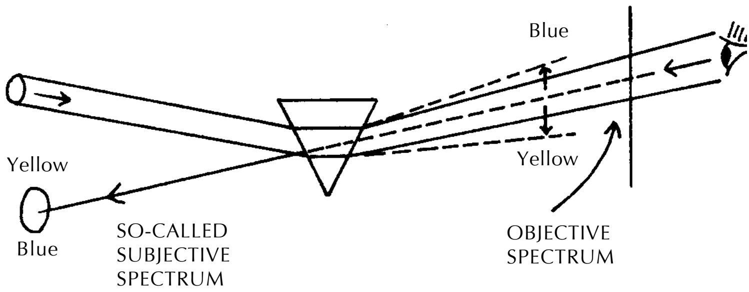


Figure 4c

What are you actually seeing? If you can imagine what you see here, and state what you are seeing purely in the context of what we have just established, then what you are actually seeing will immediately make sense to you, even in the details. All you have to do is stick with what you see. Isn't it true that, if you look at the beam of light this way, you see something bright, because the beam of light is coming toward you, but you see the brightness through darkness, through the blue color—brightness through darkness. Therefore, here you have to see yellow or reddish yellow. Isn't the fact that blue emerges here clear proof that you have something darkened up here? Down here, the red color proves the same thing—that you have something illuminated. As I already explained—the brightness drowns out the darkness. So, by looking here you see the beam of light, however bright it may be, through something illuminated. Compared with the illuminated object, the beam is something dark. So you are seeing a dark object through a bright object, and you have to see it as blue or purple at the bottom. You simply have to state the phenomenon, and then you already have what you can see. What presents itself to the eye is what else you see here—the blue that you are looking through. Thus the brightness appears reddish.

a part of what is directed at the screen from my beam of light here below will fall on the upper image. Because of the angle, more or less, the light that the upper mirror reflects is projected onto the screen, as well as that which is reflected by the lower mirror. It is as if the screen were being illuminated from two different places.

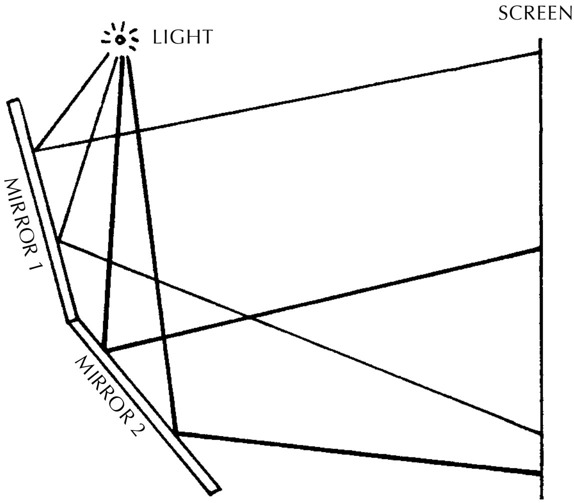


Figure 4d

Let's say that a physicist who thinks in Newtonian terms sees this. He would say to himself: There's the light source. First, it bombards the first mirror, which hurls its little spheres this way. They bounce off, arrive at the screen, and light it up. But the little spheres also bounce off the lower mirror. A lot of little spheres arrive from there. If there are two mirrors, it must be much brighter than if there were just the one mirror. If I arrange things in such a way that I take away the second mirror, then the screen would have to be illuminated less by the projected light than when I have two mirrors. Mind you, a really awkward thought could occur to brings darkness once again, which itself continues, however. Thus here we have to get alternating brightness and darkness because the upper light passes through the lower light and makes a lattice.

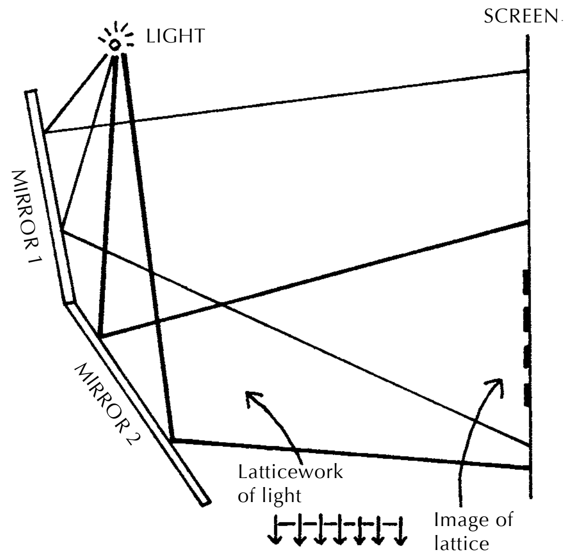


Figure 4e

I have asked you to consider this because you have to look into how a lattice emerges. You have alternating bright spots and dark spots because light is zipping into light. When light zips into light, then the light is simply cancelled. The light is transformed into darkness. We have to explain the emergence of such a lattice of light based on the arrangement we have made with these mirrors. The speed of light, indeed, any differences in the speed of light that occur here, are of no great significance. What I want to show is that what happens here inside the light itself, with the aid of the apparatus, is that the lattice is reflected here [on the screen]: light, dark, light, dark.

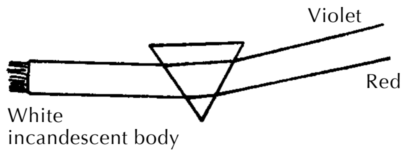


Figure 4f

Now, however, we can also produce a spectrum in a somewhat modified way. Let's say we have a prism here and we have a sodium flame here, in other words a volatile metal: sodium. The sodium turns into gas, which burns and volatilizes, and we produce a spectrum from the volatilizing sodium [Figure 4g]. Then something quite peculiar happens. If we produce the spectrum not from the sun or from a glowing solid, but from a glowing gas, then a single part of the spectrum is very strongly pronounced. In fact, sodium light tends especially to yellow. Here we have red, orange, and yellow. The yellow part is particularly strongly pronounced in sodium. The rest of the spectrum is atrophied, hardly even present, in the metal sodium. Therefore, we apparently get a narrow yellow strip; we call it a yellow band. This happens because it is part of a whole spectrum; the rest of the spectrum is just atrophied. Thus, with all different kinds of bodies we can find such spectra that aren't really spectra at all, just shining bands. From this you can conclude, conversely, that if you don't know what is actually in the flame and you create a yellow spectrum with it, then there must be sodium in the flame. You can recognize which metal you are dealing with.

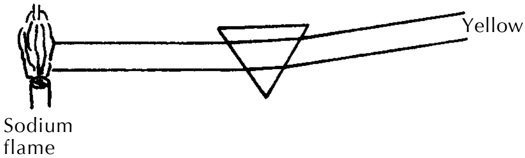


Figure 4g

An odd thing happens, however, if you combine these two experiments [Figure 4h]. We produce the beam of light here and the spectrum here, and at the same time we put the sodium flame in so that the glowing sodium unites with the beam of light. What happens there is quite similar to what I showed you a little while ago with Fresnel's experiment. We could expect that the yellow here would appear especially strong because there is already yellow in the beam, and then the yellow from the sodium is added to it. But that's not the case. Instead, the yellow from the sodium extinguishes the other yellow, and a dark spot is created. Thus, where we would expect a brighter area to emerge, a dark spot emerges! How could that be? It depends solely on the force that is generated. Let's assume that the sodium light created here was so selfless that it simply allowed the related yellow light to pass through it. Then it would have to extinguish itself completely. It doesn't do that, though. Instead it blocks the way at exactly the point where the yellow should cross. It is there. Although it is yellow, it doesn't act to strengthen. Instead, it acts to extinguish, because as a force it simply blocks the way, regardless of whether the thing that comes into its path is something else or not. That's of no importance. The yellow part of the spectrum is extinguished, and a black spot is created.

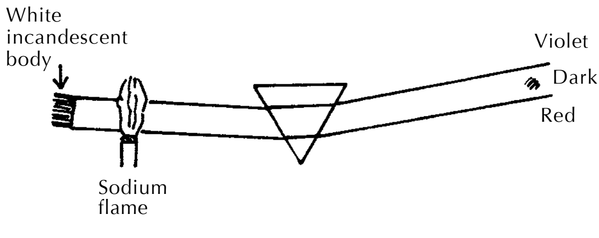


Figure 4h

From this you can see that once again you only need to consider what is there. The flood of light itself offers you the explanation. That's exactly what I would like to point out to you. You see, the physicist who explains things in the spirit of Newton would naturally have to say that if you have something white here, a strip of white for example, and look at this shining strip, then it appears to you that you're getting a spectrum: red, orange, yellow, green, blue, dark blue, violet [Figure 4i].

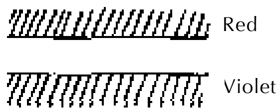


Figure 4i

Now you see, Goethe would say, "Sure, at a pinch that's all right. If nature really is such that it put light together, then we could assume of course that this light is really dissected into its parts by the prism. Wonderful. But the very same people who say that light consists of its seven parts assert at the same time that darkness is nothing at all but the absence of light. Fine, but if I leave a strip of black here between the white and look through the prism, then I also get a rainbow, only with its colors in a different arrangement. Now it's violet in the middle and becomes bluish green[8] toward one side. Here I get a band that is arranged differently, but in the spirit of the dissection theory I would have to say that the black could be broken down too. Thus I would have to admit that darkness isn't merely the absence of light. Black would have to be divisible too. However, it would also have to consist of seven colors." That's what made Goethe lose his faith[9]—he also saw the black strip in seven colors, only in a different arrangement.

afterward. Thus, the Bologna stone had developed a relationship to light, which it expressed by continuing to shine even after the light had been taken away. Therefore such stones, which were being investigated in various ways after this fashion, were called "phosphorus." So if you encounter the expression "phosphorus" in the literature of this time, you shouldn't take it to mean what we mean by it today, but rather phosphorescent bodies, light-bearers, phosphores. Now, however, this phenomenon of the afterglow, of phosphorescence, isn't actually the basic one; a different phenomenon is the basic one.

If you take ordinary oil and look through it toward something that is shining, you will see the oil as faint yellow. If, however, you place yourself so that you allow the light to pass through the oil and look at it from behind, the oil will appear to glow with a bluish light, but only as long as light is shining on it. You can carry out this experiment with various other bodies. It gets particularly interesting when you dissolve chlorophyll. If you look through such a solution into the light, it appears green. But if you place yourself behind it, so to speak, with the solution here and the light passing through here, so that you now see the place where the light passes through from behind, then the chlorophyll shines back with a reddish color—red, just as the oil shines blue [Figure 5a].

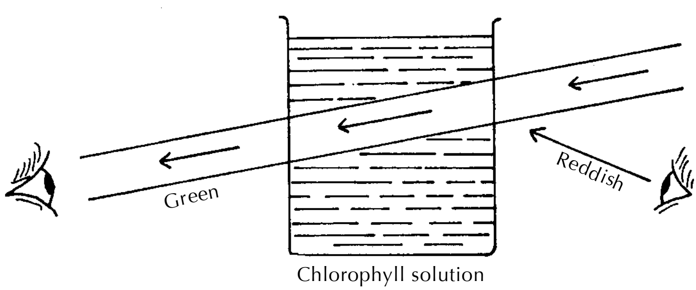


Figure 5a

space and time objective entities because we float in them with things, we should also regard light as our common element. We should regard the colors, however, as something that can appear only because we enter with our astral body into a relationship with what the light is doing there.

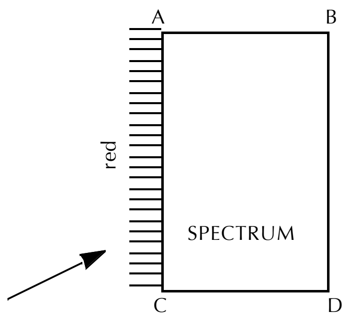


Figure 5b

Let's assume, however, that somehow you have produced some kind of color phenomenon, some kind of spectrum, in this space here, A-B-C-D, but a phenomenon that happens only in the light [Figure 5b]. Here you will have to go back to an astral relationship with the light. However, you could have colored this here as the surface so that A-C as a body appears red to you, for example. We say, "A-C is red." Then you look at the surface of the body and at first have the rough idea that under the surface of the body it is red through and through. You see—that is something different. There you also have an astral relationship, but you are separated by the surface of the body from the astral relationship you enter into with the color. Try to conceive of that! In the light you see colors, colors of the spectrum. There you have astral relations of a direct nature—nothing comes between you and these colors. You see the colors of the body; something comes between them and your

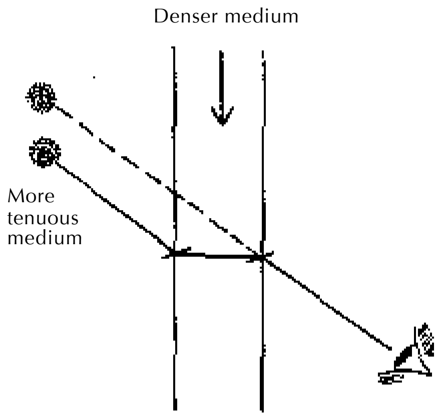


Figure 6a

Let's assume that you have the cross section of a plate of glass here. Through this plate of glass you see a shining object. I will sketch the thing, but instead of the shining object, let's say I simply draw a shining circle here [Figure 6a].[1] Now imagine yourself back on the school bench once more and recall what you actually learned from this vantage point about visual observation. You were told that rays emanated from this shining object (we're interested in a certain line of sight for the eye); in other words, in the direction of this ray the light penetrates, as they say, from a thinner medium into a denser medium. If we simply look through the plate of glass and compare what happens with what is really there, we can perceive that the shining object is displaced and appears at a different spot than when we look at it without the plate of glass. This is said to stem from the fact that the light is bent. That's what they say when the light enters a denser medium from a thinner medium. Then, in order to figure out the direction, we have to draw a so-called angle of incidence. If the light continued on its way without being hindered by a denser medium of this kind, absurdity. For even if I look at this bright spot here, it is not true that it is the only thing that is displaced. Instead, in reality this area down here, which I'll call "nothingness," is also displaced upward. Whatever is displaced is never something I can delimit so abstractly.

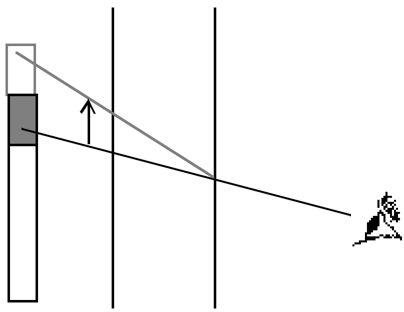


Figure 6b

Thus if I do the experiment that Newton did—if I let in a beam of light, which is diverted by the prism—then it isn't true that only the beam of light is displaced; what borders the beam of light, above and below, is displaced too. I should never speak of any sort of rays of light or the like, but of displaced light images or light spaces. And if somewhere I do want to talk about an isolated light, then I can't talk about it at all in a way that relates this isolated light to something in the theory. Rather I have to talk about it in such a way that my words refer simultaneously to what borders it.

Only if we think in this way can we really feel what is actually happening when we are faced with the origin of color phenomena. Otherwise, simply because of our way of thinking, we get the impression that the colors somehow arise from light—we have already worked out the thought that we are dealing only with light. In reality, we aren't dealing with light, but with something bright, which is bordered on one side or other. Besides these two explanations, there are all sorts of others. This is just a classic example of how we don't look at the real phenomenon, but invent all kinds of explanations.

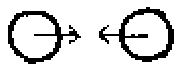


Figure 6c

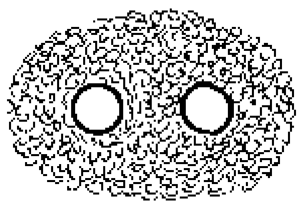


Figure 6d

But what is the real reason for this? This inventing of all kinds of unknown agencies, illusory forms of energy, which do all sorts of things—that spares us something. Of course, this theorizing about impacts was just as much an invention as the theorizing about long-distance forces. But this invention relieves us of an assumption that is frightfully uncomfortable for people today. For, you see, it is always the case that we have to wonder, if there are two mutually independent planetary bodies approaching each other, and they show it is in their nature to approach each other, then, of course, there has to be a basic principle causing their approach. There has to be a reason for their approach. It is simpler to make up forces than to say that there is yet another way, namely thinking that the planetary bodies are not independent of each other. If, for example, I lay my hand on my forehead, it won't occur to me to say, "My forehead attracts my hand." Instead I will say, "That is an inner act carried out by something that has its basis in the soul and from the fact that the light is emitted from this source and blocked by the rod. And that shadow is the one that results when the light from our right-hand light source is blocked. Basically, in other words, we are dealing here only with the creation of certain dark spaces. What lies in shadow is just a dark space. If you look at the surface of the screen outside the two shadow bands, you will realize that it is illuminated by the two light sources. So, in other words, we are dealing here with light.

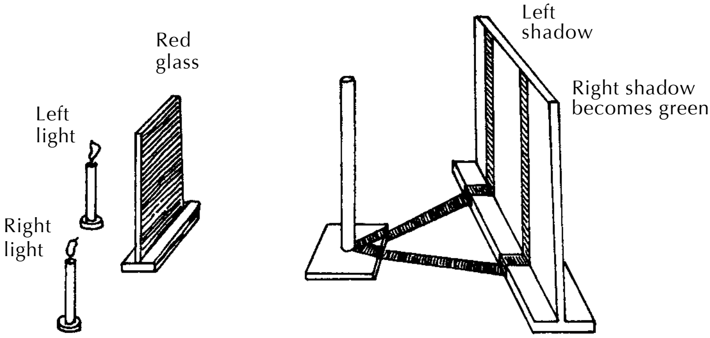


Figure 7a

Now I am going to color one of the lights. I will have it pass through a tinted glass plate so that one of the lights is colored. We know what's going to happen now: one of the lights will be dimmed. But now, you see, because of the dimming of the light, this shadow [right]—which is caused by the rod covering my left light source—turns green. It turns green in the same way that, for example, a white surface turns green when you look directly at a small red surface, then avert your eyes from it and focus them on the white surface. Then what you first saw as red turns green, without anything being there. It's as if you were projecting the green color itself onto the surface. Just as in that case you see the green surface as the afterimage of the red surface you saw before, here you see the shadow of perceived as an effect on my subjective being—which, in turn, they describe (but with what terminology!)[4] or, actually, don't describe. No matter which idea is used as the basis here, we can't get any further if we want to think things through clearly. We can't come to a conclusion about certain things that are commonly taken up, simply because this kind of physics is far from going into the facts.

In terms of the facts, you are dealing with three stages of the relationships of human beings to the outer world—the light stage, the heat stage, and the sound or acoustic stage. However, there is something very peculiar here. If you examine without bias your relationship with light, that is to say, your floating in the element of light, then you have to say that you can only inhabit the processes of the outside world as an ether organism. By inhabiting the element of heat, you are living with your entire organism in the element of heat of your surroundings. Now direct your attention downward from this aspect of living within these elements into the inhabitation of the sound and tone element. In this case, by becoming yourself an organism of the air, you actually inhabit differentiated forms of the outer air. In other words, you no longer inhabit the ether, but actually live in the external physical substance—you inhabit the air in this case. For this reason, life in the element of heat is a significant dividing line. To a certain extent, the element of heat, living within it, means a middle level for your consciousness.

Light ↑
——— Warmth ———
Air (Sound, Tone) ↓

You can perceive this level very clearly in the fact that for all intents and purposes you can hardly distinguish outer and inner heat in terms of pure sensation. However, life in the particular way that is opposed to the way they are saturated electrically by the resin-rod electricity. Therefore, with a nod to the qualitative, we differentiate between glass electricity and resin electricity, or, expressed more generally, positive electricity and negative electricity. Glass electricity is positive; resin electricity is negative.

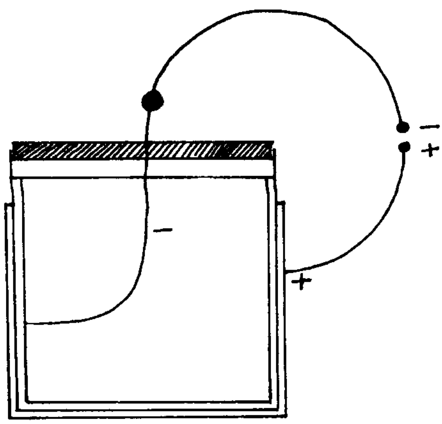


Figure 9a

Now the curious thing is that positive electricity somehow always attracts negative electricity. You can observe this phenomenon in the so-called Leyden jar. This is a vessel coated on the outside with an electrical conductor, which is isolated here, and coated on the inside with another conductor, which is attached to a metal rod with a metal knob [Figure 9a]. If we electrify a metal rod and conduct the electricity to the outer coating—which you can do—then the outer coating will become, for example, electrically positive, producing the phenomena of positive electricity, with the inner coating becoming electrically negative. Then, as you know, if we connect the coating that is imbued with positive electricity with the coating that is imbued with negative electricity, by concepts, but actually made it necessary to expand the horizons of physics to include the qualitative, could have been shown by the presence of what are called induction currents. To give you only a rough idea of this, an electrical current moving in a wire induces a current in a wire nearby simply because the two are in the same vicinity. Thus we could say more or less that effects of electricity take place across space.

Hertz arrived at the interesting insight that the transmission of electrical forces is indeed related to all the phenomena that are propagated in the form of waves or can be thought of in this way. He found that if an electrical spark is produced in the same way it is produced here, that is, if a voltage is generated, then the following result will be achieved. Let's assume that we had a spark jumping across here. Then we could place two such things—let's call them little inductors—opposite each other; they would just have to be placed facing each other in a certain position. At an appropriate distance a spark could jump across here too, which would resemble no other phenomenon so much as one where, let's say, a source of light is here, and a mirror here that reflects the beam of light, which is caught by another mirror here, with the image then appearing here [Figure 9b]. We can speak of the spreading out of light and of an effect that takes place at a distance.

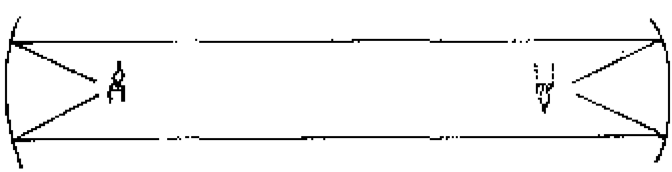


Figure 9b

So Hertz could also speak of electricity spreading out, with its effect perceptible at an appropriate distance. And in his opinion and that of others, he had brought about right "beta rays," the ones that follow the straight line "gamma rays," and the ones deflected in the opposite direction "alpha rays." By placing a magnet to the side of the radiation, we can study the deflection, make certain calculations, and thereby determine the speed of the radiation. The result is interesting: the beta rays travel at about nine-tenths the speed of light and the alpha rays at about one-tenth the speed of light.[8] Thus we have certain explosions of force, so to speak, which we can separate and analyze, and which then show conspicuous differences in speed.

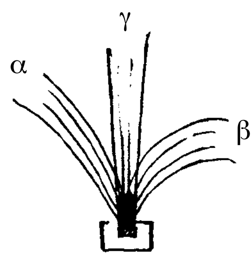


Figure 9c

At the beginning of these reflections we tried to grasp the formula $v = d/t$ purely spiritually, and we said that in space velocity is the real thing; it is the velocity that gives us the right to speak of something real. Here you see how what explodes out of here is mainly characterized by the fact that we are dealing with velocities that are acting upon each other with various strengths. Think for a moment about what it means that in the same cylinder of force radiating out from here, there is something that wants to move nine times as fast as the other; in other words one moving force that wants to hold back is asserting itself against the other force that wants to go nine times as fast. Now I want you to take a brief look at something that only we anthroposophists have the right not to regard as lunacy. Please recall how very often we had to talk about the proof for the fact that these three angles together are 180 degrees. We do this by drawing a parallel here to the base of the triangle, saying: the same angle that is here as α appears here as α^1; α and α^1 are alternate interior angles. They are equal. Thus I can simply put this angle over here [Figure 10a]. Likewise, I can put angle β over here and have the same thing. Now, angle γ stays where it is, and if $\gamma = \gamma$ and $\alpha^1 = \alpha$, and $\beta^1 = \beta$, and $\alpha^1 + \beta^1 + \gamma$ together make a straight angle, then $\alpha + \beta + \gamma$ together also have to make a straight angle. I can prove this clearly and concretely. There can't be anything clearer or more concrete, you might say.

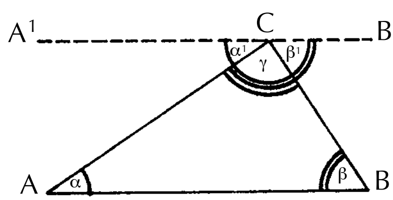


Figure 10a

However, the assumption that we make here when we prove this is that this upper line A^1B^1 is parallel to AB, because only then am I able to carry out the proof. But in all of Euclidean geometry now there is no way of proving that two lines are parallel, that is, that they intersect only at an infinite distance; in other words that they don't intersect at all. This looks as if they are parallel only as long as I stay with imaginary space. Nothing guarantees that this is also the case with real space. And if I assume only one thing—that these two lines do not intersect only at an infinite distance, but in reality intersect earlier—then my whole proof that the angles of the triangle equal 180 degrees is wrecked. Indeed, in the space that I construe for myself in my thoughts and with which normal geometry is concerned, the sum of the angles of the triangle is 180 degrees.

in the sound. When you confront electrical phenomena as a human being, at first you perceive nothing at all in the way of vibrations and the like. But you feel compelled to expand what you had previously concentrated [Figure 10c]. You push your etheric body and astral body out past your surface, and by enlarging them, perceive these electrical phenomena.

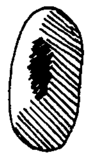


Figure 10b

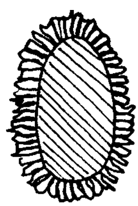


Figure 10c

Without progressing to the human spirit and soul, we will never be able to gain an understanding of natural phenomena that corresponds to truth or reality. We have to imagine more and more clearly how sound and light phenomena are related to our conscious conceptual element; electrical and magnetic phenomena, on the other hand, are related to our subconscious will element; and heat is located between them. Just as feeling is located between thinking and willing, the external heat of nature is located between light and sound on the one hand and electricity and magnetism on the other. Thus the structure for examining natural phenomena must increasingly become the study of the light and sound element, on the one hand, and of the diametrically opposed electrical-magnetic element on the