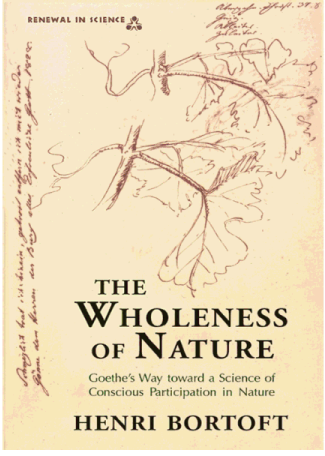

The Wholeness of Nature

Goethe's Way toward a Science of Conscious Participation in Nature

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Contents

Preface

Why would anyone in the 1990s write a book on Goethe's way of science? Perhaps because of a scholarly interest—wanting to find out the truth about Goethe's scientific ideas, to discover what he had in mind. No doubt this would be a valid reason, but it is not mine. To begin with I don't speak German, so writing a scholarly book on Goethe would be, for me, equivalent to trying to climb a mountain without first having learned to walk. But what other reason could there be for writing about the scientific work of someone who died in 1832, especially when his ideas were rejected by the scientific establishment as the work of a muddled dilettante? The widespread judgment of Goethe's science seems to be just that: Great poet and dramatist he might have been, but he didn't know what he was talking about when it came to science. But times have changed since Goethe's day. Modern science had barely begun then, whereas now it has matured and we have had a chance to see its implications and consequences more clearly. Equally important, we now understand science better—the revolution in the history and philosophy of science is responsible for that.

My interest in Goethe arose as a result of working as a postgraduate research student under David Bohm on the problem of wholeness in the quantum theory, back in the 1960s. To those of us who had the privilege to participate in his daily discussions, Bohm communicated a sense of the way that wholeness is very different from how we have become accustomed to thinking of it in modern science. When I first came across Goethe's scientific ideas, I immediately recognized in them the same kind of understanding

of wholeness that I had encountered with Bohm. But from the beginning I saw Goethe's way of science in practical terms, as something that was "do-able"—even though my own interest was, and is, largely philosophical. Because I had been taught exercises in seeing and visualization by J.G. Bennett in the 1960s, I was able to recognize what Goethe was *doing* instead of being limited to only what he was saying. So, thanks to this, I was not restricted to an intellectual approach. Working with Goethe's practical indications brought me to an understanding of Goethe's way of science which was not only more lively than, but also somewhat different from, what I could read in standard academic accounts. For example, by practicing Goethe's method of seeing and visualizing with plants, I came to experience the way that this turned the one and the many inside out. I later found that, using the same means, I could share this perception with students, and that we could begin to understand the whole and the part, the one and the many, the universal and the particular, in a radically new way. I would not have experienced this transformation in the mode of cognition for myself if I had done no more than read Goethe intellectually. What can only seem abstract to the intellectual mind becomes living experience when Goethe's practice of seeing and visualizing is followed. Doing this gives us a sense of a different kind of dimension in nature. It is no exaggeration to say that it turns our habitual way of thinking inside out, and I have tried to write this book in a way that will give readers a taste of this for themselves.

Over the past few decades, we have become increasingly aware of the importance of the cultural context within which modern science has developed. The new field of history and philosophy of

science has shown us what is referred to now as the historicity of scientific knowledge, the way that cultural-historical factors enter into the very form which scientific knowledge takes. We have, for the most part, given up thinking of science as an autonomous activity which stands outside of history, or indeed outside of any human social context, pursuing its own absolute, contextless way of acquiring pure knowledge. In fact, now we have begun to recognize that this view of science itself first arose within a particular cultural-historical context, and that it is an expression of a style of thinking which has its own validity but does not have access to "ultimate reality." We can now recognize, for example, that the fact that modern physics is true—which it certainly is—does not mean that it is fundamental. Hence it cannot be a foundation upon which everything else, human beings included, depends. Recognizing that the foundations of science are cultural-historical does not affect the truth of science, but it does put a different perspective on the fundamentalist claims made on behalf of science by some of its self-appointed missionaries today. Looked at in the light of the new discoveries in the history and philosophy of science, such claims to have found the ultimate basis of reality look like no more than quaint relics from a bygone age.

It is astonishing to realize just how modern Goethe was in this respect. Almost two hundred years ago, he discovered the historicity of science for himself, expressing it succinctly when he said, "We might venture the statement that the history of science is science itself." He came to this understanding as a result of his struggle with the science which had fundamentalist pretensions in his own day, i.e., the science of Newton. This understanding makes Goethe our contemporary. We realize now that nature can

manifest in more than one way, without needing to argue that one way is more fundamental than another. So there is the possibility that there could be a different science of nature, not contradictory but complementary to mainstream science. Both can be true, not because truth is relative, but because they reveal nature in different ways. Thus, whereas mainstream science enables us to discover the causal order in nature, Goethe's way of science enables us to discover the wholeness. I suggest that this science of the wholeness of nature is a vision much needed today in view of the limitations in the perspective of mainstream science which have now become so evident.

The three essays which appear here were written at different times and under different circumstances. "Authentic and Counterfeit Wholes" first appeared as "Counterfeit and Authentic Wholes: Finding a Means for Dwelling in Nature" in *Dwelling, Place and Environment* (1986), a collection of essays on the phenomenological approach to the human environment, edited by David Seamon and Robert Mugeraur. It is based on an earlier work, and I am very grateful to David Seamon for encouraging me to rewrite it in this form. I would like to thank the publisher, Martinus Nijhoff, for permission to reproduce it here. "Goethe's Scientific Consciousness" is a much extended version of a paper given at a conference held by the British Society for Phenomenology in 1979. It was published in 1986 in the Institute for Cultural Research Monograph Series, and I am grateful to the Council of the Institute for Cultural Research for permission to republish it here.

"Understanding Goethe's Way of Science" was written specifically for this volume. Christopher Bamford at Lindisfarne Press asked me if I had any "further thoughts" which might be added as a postscript to an American publication of "Goethe's Scientific Consciousness." I didn't realize that I had until I started to write, and I am as surprised as he is at the result. I am very grateful to him for his initial suggestion, and for his help and encouragement in getting the book into its final form. I would also like to thank Rob Baker and Albert Berry of Water-sign Resources for editing the book into a style suitable for an American readership, and for improving its general readability. I am very grateful to John Barnes, the series editor, for including this book in the Renewal in Science series, for his many helpful suggestions, and for organizing an extensive lecture tour to coincide with publication.

Finally, but by no means least, I would like to thank Jackie Bortoft, my wife, for her continued help and support. As well as word-processing my handwriting, and bringing my attention to unnecessary repetitions, she has helped me on many occasions to find how to articulate more clearly something that has been eluding me. Naturally any confusions which remain are my own responsibility.

PART I

Authentic and Counterfeit Wholes

INTRODUCTION

What is wholeness? To answer this question, it is helpful to present a specific setting. Imagine someone not yet recognizing it, asking, "What is roundness?" We might try to answer by giving a number of instances, such as "The moon is round," "The plate is round," "The coin is round," and so on. Of course "round" is none of these things, but by adducing a number of such instances we may hope to provoke the recognition of roundness. This happens when perception of the specific instances is reorganized, so that they now become like mirrors in which roundness is seen reflected. In spite of what many people might think, this process does not involve empirical generalization—i.e., abstracting what is common from a number of cases. The belief that concepts are derived directly from sensory experiences is like believing that conjurors really do produce rabbits out of hats. Just as the conjuror puts the rabbit into the hat beforehand, so the attempt to deduce the concept by abstraction in the empiricist manner presupposes the very concept it pretends to produce.

I attempt the same procedure in this essay with the aim of understanding wholeness. I adduce a number of examples of wholeness, with the aim of learning more about wholeness itself by seeing its reflection in these particular cases. I distinguish authentic wholeness from counterfeit forms in terms of the relationship between whole and part. The result leads to an understanding of how the whole can be encountered through the

parts. Finally, I argue that the way of science developed by the poet and student of nature Johann Wolfgang von Goethe (1749—1832) exemplifies the principle of authentic wholeness. Goethe's mode of understanding sees the part in light of the whole, fostering a way of science which dwells in nature.

Two Examples of Wholeness: Holograms and the Universe of Light and Matter

The advent of the laser has made possible the practical development of a radically different kind of photography. *Hologram* is the name given to the special kind of photographic plate produced with the highly coherent light of a laser—i.e., light which holds together and does not disperse, similar to a pure tone compared with noise. Whereas the ordinary photographic plate records and reproduces a flat image of an illuminated object, the hologram does not record an image of the object photographed but provides an optical reconstruction of the original object. When the hologram plate itself is illuminated with the coherent light from the laser with which it was produced, the optical effect is exactly as if the original object were being observed. What is seen is to all optical appearances the object itself in full three-dimensional form, being displaced in apparent position when seen from different perspectives (the parallax effect) in the same way as the original object.

A hologram has several remarkable properties in addition to those related to the three-dimensional nature of the optical reconstruction which it permits. The particular property which is of direct concern in understanding wholeness is the pervasiveness

of the whole optical object throughout the plate.[1] If the hologram plate is broken into fragments and one fragment is illuminated, it is found that the same three-dimensional optical reconstruction of the original object is produced. There is nothing missing; the only difference is that the reconstruction is less well defined. The entire original object can be optically reconstructed from any fragment of the original hologram, but as the fragments get smaller and smaller the resolution deteriorates until the reconstruction becomes so blotchy and ill-defined as to become unrecognizable. This property of the hologram is in striking contrast to the ordinary image-recording photographic plate. If this type of plate is broken and a fragment illuminated, the image reproduced will be that recorded on the particular fragment and no more. With orthodox photography the image fragments with the plate; with holography the image remains undivided when the plate is fragmented.

What can be seen straightaway about wholeness in this example of the hologram is the way in which the whole is present in the parts. The entire picture is wholly present in each part of the plate, so that it would not be true in this case to say that the whole is made up of parts. This point will be explored in detail shortly, but the advantage of beginning with the hologram is that it is such an immediately concrete instance of wholeness.

A second example of wholeness involves the ordinary experience of looking up at the sky at night and seeing the vast number of stars. We see this nighttime world by means of the light "carrying" the stars to us, which means that this vast expanse of sky must all be present in the light which passes through the small hole

of the pupil into the eye. Furthermore, other observers in different locations can see the same expanse of night sky. Hence we can say that the stars seen in the heavens are all present in the light which is at any eye-point. The totality is contained in each small region of space, and when we use optical instruments like a telescope, we simply reclaim more of that light.[2] If we set off in imagination to find what it would be like to be light, we come to a condition in which here is everywhere and everywhere is here. The night sky is a "space" which is one whole, enfolded in an infinite number of points and yet including all within itself.

Matter also turns out to behave in an unexpectedly holistic way at both the macroscopic and the microscopic level. We tend to think of the large-scale universe of matter as being made up of separate and independent masses interacting with one another through the force of gravity. The viewpoint which emerges from modern physics is very different from this traditional conception. It is now believed that mass is not an intrinsic property of a body, but it is in fact a reflection of the whole of the rest of the universe in that body. Einstein imagined, following Ernst Mach, that a single particle of matter would have no mass if it were not for all the rest of the matter in the universe.[3] Instead of trying to understand the universe by extrapolating from the local environment here and now to the universe as a whole, it may be useful to reverse the relationship and understand the local environment as being the result of the rest of the universe.[4]

Similarly, at the microscopic level, we tend to think of the world as being made up of separate, independent subatomic particles

interacting with one another through fields of force. But the view which emerges from physics today is very different. Particle physicists, as they are called, have found that subatomic particles cannot be considered to be made up of ultimate, simple building blocks which are separate and outside of each other. Increasingly, it becomes clear that analysis in this traditional way is inappropriate at the microscopic level. Thus, in the "bootstrap" philosophy of Geoffrey Chew, the properties of any one particle are determined by all the other particles, so that every particle is a reflection of all the others. This structure whereby a particle contains all other particles, and is also contained in each of them, is expressed succinctly by the phrase "every particle consists of all other particles."[5]

Just as there are no independently separate masses on the large scale, then, there are also no independent elementary particles on the small scale. At both levels, the whole is reflected in the parts, which in turn contribute to the whole. The whole, therefore, cannot simply be the sum of the parts—i.e., the totality—because there are no parts which are independent of the whole. For the same reason, we cannot perceive the whole by "standing back to get an overview." On the contrary, because the whole is in some way reflected in the parts, it is to be encountered by going further into the parts instead of by standing back from them.

The Hermeneutic Circle

A third instance of wholeness is externally somewhat different from the previous two. It is concerned with what happens when we read a written text. If reading is to be meaningful, it is not just a

matter of repeating the words verbally as they come up in sequence on the page. Successful reading is not just a matter of saying the words. It is an act of interpretation, but not interpretation in the subjective sense. True interpretation is actively receptive, not assertive in the sense of dominating what is read. True interpretation does not force the text into the mold of the reader's personality, or into the requirements of his previous knowledge. It conveys the meaning of the text—"conveys" in the sense of "passes through" or "goes between." This is why readers sometimes can convey to others more of the meaning of a text than they may understand themselves.

Authentic interpretation, and hence successful reading, imparts real meaning, but the question becomes, what or where is this meaning? We often say, "I see," when we wish to indicate that we have grasped something. If we try to look at what we imagine is in our grasp, however, we find ourselves empty-handed. It does not take much experimentation here to realize that meaning cannot be grasped like an object.

The meaning of a text must have something to do with the whole text. What we come to here is the fundamental distinction between whole and totality. The meaning is the whole of the text, but this whole is not the same as the totality of the text. That there is a difference between the whole and the totality is clearly demonstrated by the evident fact that we do not need the totality of the text in order to understand its meaning. We do not have the totality of the text when we read it, but only one bit after another. But we do not have to store up what is read until it is all collected together, whereupon we suddenly see the meaning all at once in an

instant. On the contrary, the meaning of the text is discerned and disclosed with progressive immanence throughout the reading of the text.

We can begin to see how remarkably similar the meaning structure of a text is to the optical form of the hologram. The totality of the text can be compared to the pattern of marks on the hologram plate. But the meaning of the text must be compared to the whole picture which can be reconstructed from the hologram plate. This is the sense in which the meaning of the text is the whole. The whole is not the totality, but the whole emerges most fully and completely through the totality. Thus, we can say that meaning is hologrammatical. The whole is present throughout all of the text, so that it is present in any part of the text. It is the presence of the whole in any part of the text which constitutes the meaning of that part of the text. Indeed, we can sometimes find that it is just the understanding of a single passage which suddenly illuminates for us the whole meaning of the text.

What we come to here is the idea of the hermeneutic circle, which was first recognized by Friedrich Ast in the eighteenth century and subsequently developed by Schleiermacher in his program for general hermeneutic s as the art of understanding.[6] At the level of discourse, this circle says that to read an author we have to understand him first, and yet we have to read him first to understand him. It appears we have to understand the whole meaning of the text "in advance" to read the parts which are our pathway towards the meaning of the text as a whole. Clearly, this is a contradiction to logic and the form of reasoning which is based thereon. Yet it is the *experience* we go through to understand the

meaning of the text, as it is also the experience we go through in writing a text. The same paradox for logic can be found at the level of the single sentence. The meaning of a sentence has the unity of a whole. We reach the meaning of the sentence through the meaning of the words, yet the meaning of the words in that sentence is determined by the meaning of the sentence as a whole.

The reciprocal relationship of part and whole which is revealed here shows us clearly that the act of understanding is not a logical act of reasoning, because such an act depends on the choice of either/or. The paradox arises from the tacit assumption of linearity—implicit in the logic of reason—which supposes that we must go either from part to whole or from whole to part. Logic is analytical, whereas meaning is evidently holistic, and hence understanding cannot be reduced to logic. We understand meaning in the moment of coalescence when the whole is reflected in the parts so that together they disclose the whole. It is because meaning is encountered in this "circle" of the reciprocal relationship of the whole and the parts that we call it the hermeneutic circle.

The Whole and the Parts

The hologram helps us to see that the essence of the whole is that it is whole. If we had begun our discussion of the whole with the statement that the whole is whole, it would have seemed to be vacuous or trivially pedantic. But the optical instance of the hologram enables us to see that, far from being a trivial tautology, this statement expresses the primacy of the whole. No matter how

often we break the hologram plate, the picture is undivided. It remains whole even while becoming many.

This essential irreducibility of the whole is so strong that it seems inconceivable that there is any way in which the whole could have parts. This is very much opposite to the view we usually have of the relation between parts and whole, which is a view that effectively denies the primacy of the whole. We are accustomed to thinking of going from parts to whole in some sort of summative manner. We think of developing the whole, even of making the whole, on the practical basis of putting parts together and making them fit. In this conventional way of working, we see the whole as developing by "integration of parts." Such a way of seeing places the whole secondary to the parts, because it necessarily implies that the whole comes after the parts. It implies a linear sequence: first the parts, then the whole. The implication is that the whole always comes later than its parts.

Faced with the primacy of the whole, as seen in the hologram, we may want to reverse the direction of this way of thinking of the whole. This we would do if we thought of the parts as being determined by the whole, defined by it, and so subservient to the whole. But this approach is not the true primacy of the whole either. It puts the whole in the position of a false transcendental which would come earlier than the parts, and so would leave them no place. This approach effectively considers the whole as if it were a part, but a "superpart" which controls and dominates the other, lesser parts. It is not the true whole, and neither can the parts be true parts when they are dominated by this counterfeit whole.

Instead, there is only the side-by-sideness of would-be parts and the counterfeit whole. This is a false dualism.

Inasmuch as the whole is whole, it is neither earlier nor later. To say that the whole is not later than the parts is not to say that we do not put parts together. Of course we do—consider the action of writing, for example. But the fact that we often put parts together does not mean that in so doing we put the whole together. Similarly, to say that the whole is not earlier than the parts is not to deny the primacy of the whole. But, at the same time, to assert the primacy of the whole is not to maintain that it is dominant, in the sense of having an external superiority over the parts.

We can see the limitation of these two extreme approaches to the whole if we look at the act of writing. We put marks for words together on a page by the movement of the pen to try to say something. What is said is not the resultant sum of the marks, nor of the words which they indicate. What is said is not produced automatically by the words adding together as they come. But equally, we do not have what is said fixed and finished in front of us before it is written. We do not simply copy what is already said. We all know the familiar experience of having the sense that we understand something and then finding that it has slipped away when we try to say it. We seem to understand already before saying, but in the moment of expression we are empty. What appears is not ready-made outside the expression. But neither is expression an invention from a vacuum.

The art of saying is in finding the "right parts." The success or failure of saying, and hence of writing, turns upon the ability to

recognize what is a part and what is not. But a part is a part only inasmuch as it serves to let the whole come forth, which is to let meaning emerge. A part is only a part according to the emergence of the whole which it serves; otherwise it is mere noise. At the same time, the whole does not dominate, for the whole cannot emerge without the parts. The hazard of emergence is such that the whole depends on the parts to be able to come forth, and the parts depend on the coming forth of the whole to be significant instead of superficial. The recognition of a part is possible only through the "coming to presence" of the whole. This fact is particularly evident in authentic writing and reading, where something is either to come to expression or to come to be understood.

We cannot separate part and whole into disjointed positions, for they are not two as in common arithmetic. The arithmetic of the whole is not numerical.[7] We do not have part *and* whole, though the number category of ordinary language will always make it seem so.[8] If we do separate part and whole into two, we appear to have an alternative of moving in a single direction, either from part to whole or from whole to part. If we start from this position, we must at least insist on moving in both directions at once, so that we have neither the resultant whole as a sum nor the transcendental whole as a dominant authority, but the emergent whole which comes forth into its parts. The character of this emergence is the "unfolding of enfolding," so that the parts are the place of the whole where it bodies forth into presence.[9] The whole imparts itself; it is accomplished through the parts it fulfills.

We can perhaps do something more to bring out the relationship between whole and part by considering the hologram again. If we break the hologram plate into fractions, we do not break the whole. The whole is present in each fraction, but its presence diminishes as the fractioning proceeds. Starting from the other end, with many fractions, we could put the fractions together to build up the totality. As we did so, the whole would emerge; it would come forth more fully as we approached the totality. But we would not be building up the whole. The whole is already present, present in the fractions, coming fully into presence in the totality. The superficial ordering of the fractional parts may be a linear series—this next to that, and so on. But the ordering of the parts with respect to the emergent whole, the essential ordering, is nested and not linear. Thus the whole emerges simultaneously with the accumulation of the parts, not because it is the sum of the parts, but because it is immanent within them.

This process tells us something fundamental about the whole in a way which shows us the significance of the parts. If the whole becomes present within its parts, then a part is a place for the "presencing" of the whole.[10] If a part is to be a place in which the whole can be present, it cannot be "any old thing." Rather, a part is special and not accidental, since it must be such as to let the whole come into presence. This speciality of the part is particularly important because it shows us the way to the whole. It clearly indicates that the way to the whole is into and through the parts. The whole is nowhere to be encountered except in the midst of the parts. It is not to be encountered by stepping back to take an overview, for it is not over and above the parts, as if it

were some superior, all-encompassing entity. The whole is to be encountered by stepping right into the parts. This is how we enter into the nesting of the whole, and thus move into the whole as we pass through the parts.

This dual movement, into the whole through the parts, is demonstrated clearly in the experience of speaking and reading, listening and writing. We can see that in each case there is a dual movement: we move through the parts to enter into the whole which becomes present within the parts. When we understand, both movements come together. When we do not understand, we merely pass along the parts. Consider, for example, the interpretation of a difficult text, say, Kant's *Critique of Pure Reason*. At first encounter, we just pass along the parts, reading the sentences without understanding. To come to understand the text, we have to enter into it, and we do this in the first place by experiencing the meaning of the sentences. We enter into the text as the medium of meaning through the sentences themselves, putting ourselves into the text in a way which makes us available to meaning. We do not stand back to get an overview of all the sentences, in the hope that this will give us the meaning of the text. We do not refer the text to some other, external text which will give us the meaning. There is no superior text which can be an authority in interpretation because there is no access to the meaning of Kant's book other than through the text itself. Even for Kant, there was no pure "meaning in itself," present as an object in his consciousness, which he then represented in language. The original text is already an interpretation, and every text written about Kant's book is itself an expression of the meaning which that book was written to make evident. The hermeneutic approach

must recognize, as Heidegger said, that "... what is essential in all philosophical discourse is not found in the specific propositions of which it is composed but in that which, although unstated as such, is made evident through these propositions."[11] Authentic interpretation recognizes the way in which the whole, which is the meaning of the text, comes to presence in the parts, which are the sentences.

Encountering the Whole: The Active Absence

Everything we encounter in the world can be said to be either one thing or another, either this or that, either before or after, and so on. Wherever we look, there are different things to be distinguished from one another: this book here, that pen there, the table underneath, and so on. Each thing is outside the other, and all things are separate from one another. But in recognizing the things about us in this way we, too, are separate from and outside of each of the things we see. We find ourselves side by side, together with and separate from, the things we recognize. This is the familiar spectator awareness. In the moment of recognizing a thing, we stand outside of that thing; and in the moment of so standing outside of that thing, we turn into an "I" which knows that thing, for there cannot be an "outside" without the distinction of something being outside of some other thing. Thus, the "I" of "I know" arises in the knowing of something in the moment of recognition of the thing known. By virtue of its origin, the "I" which knows is outside of what it knows.

We cannot know the whole in the way in which we know things because we cannot recognize the whole as a thing. If the whole were available to be recognized in the same way as we recognize the things which surround us, then the whole would be counted among those things as one of them. We could point and say "Here is this," and "There is that," and "That's the whole over there." If we had the power of such recognition, we would know the whole in the same way that we know its parts, for the whole itself would simply be numbered among its parts. The whole would be outside its parts in the same way that each part is outside all the other parts. But the whole comes into presence within its parts, and we cannot encounter the whole in the same way that we encounter the parts. We should not think of the whole as if it were a thing.

Our everyday awareness is occupied with things. The whole is absent to this awareness because it is not a thing among things. To everyday awareness, the whole is no-thing, and since this awareness is awareness of *something*, no-thing is nothing. The whole which is no-thing is taken as mere nothing, in which case it vanishes. When this loss happens, we are left with a world of things, and the apparent task of putting them together to make a whole. Such an effort disregards the authentic whole.

The other choice is to take the whole to be no-thing but not nothing. This possibility is difficult for our everyday awareness, which cannot distinguish the two. Yet we have an illustration immediately on hand with the experience of reading. We do not take the meaning of a sentence to be a word. The meaning of a sentence is no-word. But evidently this is not the same as nothing, for if it were we could never read! The whole becomes present

within parts, but from the standpoint of the awareness which grasps the external parts, the whole is an absence. This absence, however, is not the same as nothing. Rather, it is an *active* absence inasmuch as we do not try to be aware of the whole, as if we could grasp it like a part, but instead let ourselves be open to be moved by the whole.

A particularly graphic illustration of the development of a sensitivity to the whole as an active absence is to be found in the experience of writing, where we saw earlier that we do not have the meaning before us like an object. Another illustration of the active absence is provided by the enacting of a play. Actors do not stand away from a part as if it were an object. They enter into a part in such a way that they enter into the play. If the play is constructed well, the whole play comes into presence within the parts so that an actor encounters the play through his or her part. But actors do not encounter the play as an object of knowledge over which they can stand like the lines they learn. They encounter the play in their part as an active absence which can begin to move them. When this happens, an actor starts to be acted by the play, instead of trying to act the play. The origin of the acting becomes the play itself, instead of the actor s subjective "I." The actor no longer imposes himself or herself on the play as if it were an object to be mastered, but he or she listens to the play and allows himself or herself to be moved by it. In this way actors enter into their parts in such a way that the play speaks through them. This is how, their awareness being occupied with the lines to be spoken, they encounter the whole which is the play—not as an object but as an active absence.

Developmental psychology now offers considerable support for this notion that the whole is "nothing" to our ordinary awareness, as well as for the notion that we can develop a sensitivity to the whole as an "active absence." Psychologists have discovered that there are two major modes of organization for a human being: the action mode and the receptive mode.[12] In the early infant state, we are in the receptive mode, but this is gradually dominated by the development of the action mode of organization that is formed in us by our interaction with the physical environment. Through the manipulation of physical bodies, and especially solid bodies, we develop the ability to focus the attention and perceive boundaries—i.e., to discriminate, analyze, and divide the world up into objects. The internalization of this experience of manipulating physical bodies gives us the object-based logic which Henri Bergson called "the logic of solids."[13] This process has been described in detail by psychologists from Helmholtz down to Piaget. The result is an analytical mode of consciousness attuned to our experience with solid bodies. This kind of consciousness is institutionalized by the structure of our language, which favors the active mode of organization. As a result, we are well prepared to perceive selectively only some of the possible features of experience.

The alternative mode of organization, the receptive mode, is one which allows events to happen—for example, the play above. Instead of being verbal, analytical, sequential, and logical, this mode of consciousness is nonverbal, holistic, nonlinear, and intuitive. It emphasizes the sensory and perceptual instead of the

rational categories of the action mode. It is based on taking in, rather than manipulating, the environment.

For reasons of biological survival, the analytic mode has become dominant in human experience. This mode of consciousness corresponds to the object world, and since we are not aware of our own mode of consciousness directly, we inevitably identify this world as the only reality. It is because of this mode of consciousness that the whole is "nothing" to our awareness, and also that when we encounter it, we do so as an "active absence." If we were re-educated in the receptive mode of consciousness, our encounter with wholeness would be considerably different, and we would see many new things about our world.

WHOLENESS IN SCIENCE

There are many hermeneutic illustrations of the active absence—speaking, reading, playing a game, and so on—which are similar to the actor playing a part in a play. These examples can each demonstrate the reversal which comes in turning from awareness of an object into the encounter with the whole. This turning around, from grasping to being receptive, from awareness of an object to letting an absence be active, is a reversal which is the practical consequence of choosing the path which assents to the whole as no-thing and not mere nothing.

It is because of this reversal that the authentic whole must be invisible to the scientific approach, as currently conceived. The paradigm for modern scientific method is Kant's "appointed judge who compels the witnesses to answer questions which he has

himself formulated."[14] Science believes itself to be objective, but is in essence subjective because the witness is compelled to answer questions *which the scientist himself has formulated*. Scientists never notice the circularity in this because they believe they hear the voice of "nature" speaking, not realizing that it is the transposed echo of their own voice. Modern positivist science can only approach the whole as if it were a thing among things. Thus the scientist tries to grasp the whole as an object for interrogation. So it is that science today, by virtue of the method which is its hallmark, is left with a fragmented world of things which it must then try to put together.

The introduction of a quantitative, mathematical method in science led to the distinction between primary and secondary qualities.[15] The so-called primary qualities—like number, magnitude, position, and so on—can be expressed mathematically. But such secondary qualities as color, taste, and sound cannot be expressed mathematically in any direct way. This distinction has been made into the basis for a dualism in which only the primary qualities are considered to be real. Any secondary quality is supposed to be the result of the effect on the senses of the primary qualities, being no more than a subjective experience and not itself a part of "objective" nature.

The result of this dualistic approach is that the features of nature which we encounter most immediately in our experience are judged to be unreal—just illusions of the senses. In contrast, what is real is not evident to the senses and has to be attained through the use of intellectual reasoning. Thus, one group of qualities

is imagined to be hidden behind the other group, hidden by the appearances, so that a secondary quality is understood when it is seen how it could have arisen from the primary qualities. The reality of nature is not identical to the appearances which our senses give, and a major aim of positivist science is to *replace the phenomenon* with a mathematical model which can incorporate only the primary qualities. This quantitative result is then supposed to be more real than the phenomenon observed by the senses, and the task of science becomes a kind of "metaphysical archaeology" which strives to reveal an underlying mathematical reality.

The way this approach works in practice can be illustrated by Newton's treatment of the colors produced by a prism. His method was to correlate all observations of secondary qualities with measurements of primary qualities, so as to eliminate the secondary qualities from the scientific description of the world.[16] Newton eliminated color by correlating it with the "degree of refrangibility" (what we would now call "angle of refraction") of the different colors when the sun's light passes through a prism. Thus refraction can be represented numerically, and the ultimate aim of substituting a series of numbers for the sensory experience of different colors is achieved (later the wavelength of light would replace refrangibility). Hence, something which can be measured replaced the phenomenon of color, and in this way color *as color* was eliminated from the scientific account of the world.

GOETHE'S WAY OF SCIENCE

Newton's approach to light and color illustrates the extraordinary degree to which modern science stands outside of the

phenomenon, the ideal of understanding being reached when the scientist is as far removed as possible from the experience.[17] The physics of color could now be understood just as well by a person who is color-blind. There is little wonder that the successful development of physics has led to an ever-increasing alienation of the universe of physics from the world of our everyday experience.[18]

Goethe's approach to color was very different from Newton's analytic approach. Goethe attempted to develop a physics of color which was based on everyday experience. He worked to achieve an authentic wholeness by *dwelling in the phenomenon* instead of replacing it with a mathematical representation.

Goethe's objection to Newton's procedure was that he had taken a complicated phenomenon as his basis and tried to explain what was simple by means of something more complex.[19] To Goethe, Newton's procedure was upside down. Newton had arranged for the light from a tiny hole in a window shutter to pass through a glass prism onto the opposite wall. The spectrum of colors formed in this way was a well-known phenomenon at the time, but Newton's contribution was to explain it in a new way. He believed that the colors were already present in the light from the sun coming through the hole, and the effect of the prism was to separate them. It would be quite wrong to say, as is said so often in physics textbooks, that *the experiment showed* Newton this, or that he was *led to believe* this by the experiment. Rather, it was Newton's way of seeing which constituted the experiment's being seen in this way. He saw the idea (that white light is a mixture of colors which are sorted out by the prism) "reflected" in the

experiment, as if it were a mirror to his thinking; he did not derive it from the experiment in the way that is often believed.

In contrast to Newton, Goethe set out to find the simplest possible color phenomenon and make this his basis for understanding color in more complex situations. He believed Newton erred in thinking colorless light was compounded of colored lights because colored light is darker than colorless light, and this would mean that several darker lights were added together to make a brighter light. Goethe looked first at the colors which are formed when the prism is used with light in the natural environment, instead of the restricted and artificial environment which he felt Newton had selected as the experimental basis for his approach. By doing this, Goethe recognized that the phenomenon of prismatic colors depended on a boundary between light and dark regions. Far from the colors somehow being already *contained* in light, for Goethe they *came into being* out of a relationship between light and darkness.

To Goethe, the prism was a complicating factor, and so to understand the arising of colors, he looked for the more simple cases, which meant looking for situations where there are no secondary factors, only light and darkness. Such a case is what Goethe first called *das reine Phänomen* (the "pure phenomenon"), and for which he later used the term *Urphänomen* ("primal or archetypal phenomenon").[20] He found the primal phenomenon of color in the color phenomena which are associated with semi-transparent media. When light is seen through such a medium, it darkens first to yellow and then orange and red as the medium

thickens. Alternatively, when darkness is seen through an illuminated medium, it lightens to violet and then blue. Such a phenomenon is particularly evident with atmospheric colors, such as the colors of the sun and the sky and the way that these change with atmospheric conditions. Thus, it was in the natural environment that Goethe first recognized the primal phenomenon of color to be the lightening of dark to give violet and blue, and the darkening of light to give yellow and red. He expressed this process poetically as "the deeds and sufferings of light."[21]

Once Goethe had found this primal phenomenon he was in a position to see how the colors change from one to another as conditions change. He could see how these shifts were at the root of more complex phenomena such as the prismatic colors. One result is that a dynamic wholeness is perceived in the prismatic colors—a wholeness totally lacking in Newton's account. In other words, Goethe's presentation describes the origin of colors whereas Newton's does not. The colors of the spectrum are simply not intelligible in Newton's account because there is no inherent reason why there should be red, or blue, or green, as there is no reason why they should appear in the order that they do in the spectrum. But with Goethe's account, one can understand both the quality of the colors and the relationship between them, so that we can perceive the wholeness of the phenomenon without going beyond what can be experienced. Goethe's method was to extend and deepen his experience of the phenomenon until he reached that element of the phenomenon which is not given externally to sense experience. This is the connection or relationship in the phenomenon which he called the *law (Gesetz)*, and which he found

by going more deeply into the phenomenon instead of standing back from it or trying to go beyond it intellectually to something which could not be experienced.[22] In other words, Goethe believed that the organization or unity of the phenomenon is real and can be *experienced*, but that it is not evident to sensory experience. It is perceived by an intuitive experience—what Goethe called *Anschauung*, which "may be held to signify the *intuitive knowledge gained through contemplation of the visible aspect*."[23]

In following Goethe's approach to scientific knowledge, one finds that the wholeness of the phenomenon is intensive. The experience is one of entering into a dimension which is in the phenomenon, not behind or beyond it, but which is not visible at first. It is perceived through the mind, when the mind functions as an organ of perception instead of the medium of logical thought. Whereas mathematical science begins by transforming the contents of sensory perception into quantitative values and establishing a relationship between them, Goethe looked for a relationship between the perceptible elements which left the contents of perception unchanged. He tried to see these elements themselves holistically instead of replacing them by a mathematical relationship. As Cassirer said, "The mathematical formula strives to make the phenomena calculable, that of Goethe to make them visible."[24]

It seems clear from his way of working that Goethe could be described correctly as a *phenomenologist* of nature, since his approach to knowledge was to let the phenomenon become fully visible without imposing subjective mental constructs. He was

especially scathing towards the kind of theory which attempted to explain the phenomenon by some kind of hidden mechanism. He saw this style of analysis as an attempt to introduce fanciful sensory-like elements behind the appearances, to which the human mind then had to be denied direct access. He thought Descartes' attempt to imagine such mechanical models behind the appearances was debasing to the mind, and no doubt he would have felt the same way about Einstein's picture of the impregnable watch as an analogy for the situation facing the scientific investigator.[25] Goethe did not examine the phenomenon intellectually, but rather tried to visualize the phenomenon in his mind in a sensory way—by the process which he called "exact sensorial imagination" (*exakte sinnliche Phantasie*).[26] Goethe's way of thinking is concrete, not abstract, and can be described as one of dwelling in the phenomenon.[27]

THE UR-PHENOMENON

The notion of the *Urphänomen* is an invaluable illustration of the concrete nature of Goethe's way of thinking which dwells in the phenomenon. The primal phenomenon is not to be thought of as a generalization from observations, produced by abstracting from different instances something that is common to them. If this were the case, one would arrive at an abstracted unity with the dead quality of a lowest common denominator. For Goethe, the primal phenomenon was a concrete instance—what he called "an instance worth a thousand, bearing all within itself."[28] In a moment of intuitive perception, the universal is seen within the particular, so that the particular instance is seen as a living manifestation

of the universal. What is merely particular in one perspective is simultaneously universal in another way of seeing. In other words, the particular becomes symbolic of the universal.[29]

In terms of the category of wholeness, the primal phenomenon is an example of the whole which is present in the part. Goethe himself said as much when he called it "an instance worth a thousand," and described it as "bearing all within itself." It is the authentic whole which is reached by going into the parts, whereas a generalization is the counterfeit whole that is obtained by standing back from the parts to get an overview. Looking for the *Urphänomen* is an example of looking for the right part—i.e., the part which contains the whole. This way of seeing illustrates the simultaneous, reciprocal relationship between part and whole, whereby the whole cannot appear until the part is recognized, but the part cannot be recognized as such without the whole.

For example, Goethe was able to "read" how colors arise in the way that the colors of the sun and the sky change with the atmospheric conditions throughout the day. Because there were no secondary, complicating factors, this was for him an instance of the primal phenomenon of the arising of colors. This phenomenon was perceived as a part which contained the whole, and it was, in fact, through the observation of this particular phenomenon that Goethe first learned to see intuitively the law of the origin of color. Yet, the way that the colors of the sun and sky change *together* does not stand out as a phenomenon until it is seen as an instance of how colors arise. The search for the primal phenomenon is like creative writing, where the need is to find the right expression to let the meaning come forth. By analogy, we can say that Goethe's way

of science is "hermeneutical." Once the primal phenomenon has been discovered in a single case, it can be recognized elsewhere in nature and in artificial situations where superficially it may appear to be very different. These varying instances can be compared to the fragments of a hologram.

Newton, in contrast, tried to divide light into parts: the colors of the spectrum from red through to blue. But these are not true parts because each does not contain the whole, and hence they do not serve to let the whole come forth. Colorless light, or white light, is imagined to be a summative totality of these colors. Newton tried to go analytically from whole to parts (white light separated into colors), and from parts to whole (colors combined to make white light). In contrast, Goethe encountered the wholeness of the phenomenon through the intuitive mode of consciousness, which is receptive to the phenomenon instead of dividing it according to external categories.[30]

Conclusion

The experience of authentic wholeness requires a new style of learning largely ignored in our schools and universities today. Typically, modern education is grounded in the intellectual faculty, whose analytical capacity alone is developed, mostly through verbal reasoning. One notes, for example, that science students are often not interested in observing phenomena of nature; if asked to do so, they become easily bored. Their observations often bear little resemblance to the phenomenon itself.[31] These students are much happier with textbook descriptions and

explanations, a fact readily understandable once one recognizes that most educational experience unfolds in terms of one mode of consciousness—the verbal, rational mode.

The experience of authentic wholeness is impossible in this mode of consciousness, and a complementary style of understanding could usefully be developed. This can be done, first by learning to work with mental images in a way emulating Goethe—i.e., forming images from sensory experiences. In turn, this process requires careful observation of the phenomenon. Authentic wholeness means that the whole is in the part; hence careful attention must be given to the parts instead of to general principles. In contrast, an intellectual approach to scientific education begins by seeing the phenomenon as an instance of general principles.

Working with mental images activates a different mode of consciousness which is holistic and intuitive. One area where this style of learning is now used practically is in transpersonal education.[32] Experiments with guided imagination indicate that a frequent result is the extension of feelings, whereby the student experiences a deeper, more direct contact with the phenomenon imagined.[33] In this way, a more comprehensive and complete encounter with the phenomenon results, and aspects of the phenomenon otherwise unnoticed often come to light. In addition, students feel themselves to be more in harmony with the phenomenon, as if they themselves were participating in it. This leads to an attitude toward nature more grounded in concern, respect, and responsibility.[34]

Goethe's way of science is not the only direction for a way of learning grounded in authentic wholeness. In more general terms, such a style of education and science is phenomenological, letting things become manifest as they show themselves without forcing our own categories on them. This kind of learning and science goes beyond the surface of the phenomenon, but not behind it to contrive some causal mechanism described by a model borrowed from somewhere else. A contemporary illustration of such an approach is the work of biologist Wolfgang Schad in his zoological study, *Man and Mammals*.[35] Schad shows how all mammals can be understood in terms of the way in which the whole is present in the parts. In addition, he demonstrates how each mammal can be understood in terms of its own overall organization.

Schad begins with the direct observation of the immediate phenomena, working to rediscover the uniqueness of individual animals. According to Schad's approach, every detail of an animal is a reflection of its basic organization. Thus, he does not begin by replacing the phenomenon with a stereotype, but rather searches for the animal's unique qualities. This approach does not lead to fragmentation and multiplicity. Instead, it leads to the perception of diversity within unity, whereby the unique quality of each mammal is seen holistically within the context of other mammals. With a wealth of drawings and photographs, Schad demonstrates how going into the part to encounter the whole leads to a holistic perspective. He shows that multiplicity in unity means seeing uniqueness without fragmentation.

The counterfeit approach to wholeness—i.e., going away from the part to get an overview—leads only to the abstraction of the general case, which has the quality of uniformity rather than uniqueness. Schad indicates how a biology grounded in authentic wholeness can recognize the inner organic order in an animal in such a way that its individual features can be explained by the basic organization of the animal itself. In short, the mammal "explains" itself. For example, the formation of the hedgehog's horny quills is explained in terms of the basic organization of the hedgehog itself. Other questions for which Schad provides answers include why cattle have horns and deer, antlers; why leopards are spotted and zebras, striped; why otters, beavers, seals, and hippopotami live in water; why giraffes' necks are long; why rhinoceroses are horned. Schad convincingly demonstrates that features such as these can be explained through careful observation of a particular mammal's organization in the context of all the other mammals.

Like Goethe's, Schad's way of science is phenomenological and hermeneutical. It is phenomenological because the animal is capable of disclosing itself in terms of itself. Phenomenology, said Heidegger, is the attempt "to let that which shows itself be seen from itself in the very way in which it shows itself from itself."[36] Phenomenology brings to light what is hidden at first. Schad discovers in the animal the qualities which make that animal what it is rather than some other creature. In addition, Schad's work is hermeneutical, since when the point is reached where the animal discloses itself, the animal becomes its own language. In this sense, Schad's way of seeing echoes the universal sense of

Gadamer 's hermeneutics, in which “being that can be understood is language.”[37]

As Schad's work suggests, Goethe's way of science did not end with him. His style of learning and understanding belongs not to the past but to the future. It is widely acknowledged today that, through the growth of the science of matter, the Western mind has become removed from contact with nature. Contemporary problems, many arising from modern scientific method, confront people with the fact that they have become divorced from a realistic appreciation of their place in the larger world. At the same time, there is a growing demand for a renewal of contact with nature. It is not enough to dwell in nature sentimentally and aesthetically, grafting such awareness to a scientific infrastructure which largely denies nature. The need is for a new science of nature, different from the science of matter and based on other human faculties besides the analytic mind. A basis for this science is the discovery of authentic wholeness.[38]

PART II

Goethe's Scientific Consciousness

1

Introduction

Goethe does not fit easily into our categories. He was a person who was both poet and scientist, who is renowned for his poetical and dramatic work, and yet who considered that his science was the most important work he had done. We could easily accept a scientist who wrote poetry, perhaps even a poet who wrote about science, but it is difficult to accept a poet who was simultaneously an original scientist, i.e., who did science in an original way. We just cannot easily believe that what he did was really science at all.

When faced with this kind of contradiction in our cultural categories, we rationalize. One form which this takes is the accusation of dilettantism. Master among poets Goethe may have been, but as a scientist he was an amateur—and a bungling one at that in his work on color. We can compare this view with an impression of Goethe's home in Weimar as it was kept towards the end of the last century. Rudolf Magnus described how he found in it numerous specimens from Goethe's work in geology (more than eighteen thousand specimens), botany, and zoology, together with many instruments from experiments in electricity and optics. Magnus was particularly impressed with the wealth of equipment Goethe used in his optical studies, and he said: "I can testify from personal experience to the extraordinary fascination of repeating Goethe's experiments with his own instruments, of realizing the accuracy of his observations, the telling faithfulness with which

he described everything he saw."[1] From this description we do not get the impression of a dilettante, nor of a person who thought of himself first and foremost as a poet. In fact, Goethe spent twenty years of painstaking work on his research into the phenomena of color. He said himself: "Not through an extraordinary spiritual gift, not through momentary inspiration, unexpected and unique, but through consistent work did I eventually achieve such satisfactory results." Although Goethe said this specifically about his work on the metamorphosis of plants, it applied equally to all his scientific work.

Another form which the rationalization can take is the apology for the "Great Man." We can see this illustrated very clearly in the case of Isaac Newton, to whom Goethe was so opposed in his theory of color. It used to be an embarrassment that this person, who above all others set the seal on the future development of science in the West, in fact spent more of his time on occult researches and alchemy than he ever did on experimental and mathematical physics. When Newton's alchemical papers were auctioned at Sotheby's in 1936, John Maynard Keynes read through them and declared that Newton was not the first of the age of reason but the last of the magicians. The strategy was then either to ignore this "unfortunate" fact, or else to make apologies for Newton on the basis that great geniuses have their weaknesses, and we must not pay too much attention to them. But during the past two decades there has been a significant change in attitude among historians of science. It is now recognized that we cannot just ignore or dismiss approaches which do not fit in with what has become fashionable, if we want to understand how science

developed historically. What later generations find an embarrassment, or otherwise objectionable, may in fact be something which needs to be taken seriously. In the case of Goethe, this means taking seriously a radically different way of doing science.

It is a superficial habit of mind to invent the past which fits the present. At the level of the individual, this takes the form of rewriting his or her own biography. This phenomenon is well known to psychologists, who recognize it as a variation of the self-fulfilling prophecy. The same mental habit can be seen operating at a more general historical level, where it takes on the form of an assumption that the purpose of the past is to prepare the way for the present. But the past, in this case, becomes no more than an extrapolation from the present. In other words, it is our invention. The result of doing this is that history can be told as a simple tale, because it seems as if there is a single, continuous line leading from the past to the present. The characters in this single-line story fall into two simple categories: forward-looking or backward-looking, depending on whether they seem to fit on the line of extrapolation or not.[2]

Now that this kind of superficial story has been exploded by studies in the history of science, it is clear that there never was a single line of development leading to the kind of science we have today. Furthermore, it has also become clear, from these same studies, that the reasons for the success, or otherwise, of a particular science are not internal to that science. It has been widely believed that science advances by the use of its own

internal method for attaining the truth, so that scientific knowledge is legitimated by its own authority. However, it turns out that there is no such method, and science is best understood as a culturally based activity, i.e., as the product of a social process. Hence, the reasons for the acceptance of a scientific theory often have more to do with complex cultural factors than with the intrinsic merits of the theory in question. This has been borne out, for example, in studies of the seventeenth-century scientific revolution, where it has been shown that the success of the mechanical philosophy was due as much to external political and religious reasons as to its having been shown to be true by any internal scientific method. There are deeply rooted philosophical fashions in science, without which there would not be any science, but which stand outside the orbit of what can be verified scientifically. It is useful to remember this when looking at Goethe's way of science. For example, Goethe's physics of color contradicted Newton's, and if it is believed that Newton's physics of color has been shown to be true by "scientific method," then it *must* appear that Goethe's physics was wrong.

It now becomes clearer why Goethe's scientific work has often been received with disbelief. This does not necessarily have anything to do with the intrinsic scientific merit of his work. It has more to do with the state of mind (and what formed it) of those who reject his work as "unscientific" or "wrong." However, it is noticeable that both the rejection and the rationalization of Goethe's scientific work often come from students of the humanities, and not so much from scientists. It is often those who are primarily interested in Goethe as a poet who have the greatest difficulty integrating his scientific work into their perspective.

Among scientists we often find respect for Goethe's scientific endeavors, even when there is disagreement. It is acknowledged, for example, that he was a pioneer in the study of plant and animal form—for which he coined the term "morphology." There is also some speculation that he anticipated the theory of evolution. This is a notoriously tricky point, and there have been many arguments for and against it. The difficulty is resolved when it is realized that today evolution is identified with Darwin's mechanism of random variation and natural selection. This means that there can be other ideas of evolution which are not recognized as such. For Goethe, as for his contemporaries in the philosophy of nature, there certainly was the idea of evolution. Frau von Stein wrote in a letter in 1784 that "Herder's new writing makes it seem likely that we were plants and animals. Goethe ponders now with abundant ideas over these things, and what has first passed through his mind becomes increasingly interesting."[3] The idea of evolution was certainly in Goethe's mind, but it was not *Darwinian* evolution.

Goethe's major study in physics was concerned with color. His magnum opus, *Theory of Colors*, was rejected by the establishment because of the attack on Newton which it contained. Newton had been raised on a pedestal by those who came after him, so that Goethe's physics of color rebounded on its originator because it did not look like physics. In fact, on account of this work, Goethe is now looked upon by experimental psychologists of color as one of the founders of their science. What interests the physicist today about Goethe's work on color is not so much the details, but the *kind* of scientific theory which he developed. This was very different from the kind of theory which aimed to go behind

the phenomenon as it appeared to the senses, in order to explain it in terms of some hidden mechanism supposed to be more real. Goethe's approach was to avoid reducing the phenomenon to the mere effect of a mechanism hidden behind the scenes. Instead, he tried to find the unity and wholeness in the phenomena of color by perceiving the relationships in these phenomena as they are observed. The result was a theory which could be described as a phenomenology of color, rather than an explanatory model. This will be discussed in more detail below. In thus renouncing models and rooting the theory in the concrete phenomenon, Goethe now sounds very much in line with the debates about the nature of physical theory which have arisen through the development of quantum physics. His work was in fact discussed in this context at a conference on the quantum theory held in Cambridge in 1968.[4] This comparison may well be superficial, but it does mean that Goethe's scientific method, and the philosophy of science which it reflects, are taken seriously by modern physicists, who are faced with an epistemological crisis in their science.

But the value of Goethe's science is not revealed by assimilating him into the mainstream. Unfortunately, historians of science are often only interested in whether Goethe's work is a contribution to biology, or experimental psychology, or the method of physics. This approach to Goethe misses what is important, and interesting, in his scientific work. The factor which is missing from this academic approach is simply Goethe's whole way of seeing. In a letter from Italy in 1787, Goethe wrote: “After what I have seen of plants and fishes in the region of Naples, in Sicily, I should be sorely tempted, if I were ten years younger, to make a journey to

India—not for the purpose of discovering something new, but in order to view in my way what has been discovered."[5] Goethe was indicating here that the discovery of new facts was of secondary importance to him. What mattered was the *way* of seeing, which influenced all the facts. His scientific work was fundamentally an expression of this way of seeing, with the result that it is present throughout all of it, immediately yet intangibly. What we recognize as the content of Goethe's scientific work should really be looked upon as only the container. The real content is the way of seeing. So what we have to aim for, if we are to understand Goethe's scientific consciousness, is inside-out to what we expect, because it is to be found in the way of seeing and not in the factual content of what is seen.

The problem for us is that we think of a way of seeing as something entirely subjective. As victims of the Cartesian confinement of consciousness to the purely subjective, we cannot believe at first that what Goethe experienced as a way of seeing could be an objective feature of the world. The difficulty here comes from the fact that a way of seeing is not itself something which is seen. What is experienced in the way of seeing cannot be grasped like an object, to appear as a content of perception. What is encountered in the way of seeing is the *organization* or *unity* of the world. Just as the organization of a drawing is not part of the sense-perceptible content of the drawing (whereabouts on the page is the organization?), so the organization of the world of nature is not part of the sensory content of that world.[6] But what "organization" and "unity" mean turns out to depend on the *mode*

of consciousness—which will be discussed in the second chapter here.

To understand Goethe's way of seeing we would have to experience it for ourselves. We could only really understand it by participation, which means we would each experience Goethe's way of seeing as the way in which our own mind became organized temporarily. This brings us to another problem. If we believe that a way of seeing is only a subjective factor, then we must believe Goethe's way of seeing died with him. If this is so, then any attempt to understand it would entail the absurd requirement of trying to become Goethe! But this problem disappears when it is recognized that what is experienced as a way of seeing *is* the unity of the phenomenon. It follows immediately that any number of individuals can experience the same way of seeing without the restriction of time. A way of seeing has the temporal quality of belonging to "the present" instead of to the past. It is more like an event of perception in which we can learn to participate, instead of repeating something which once happened and has now gone. Goethe himself had to learn to see in the way which we now call "Goethe's way of seeing." We will now explore this way of seeing, as it is present first in his work on color and then in his work on organic nature.

2

Making the Phenomenon Visible

Goethe became interested in color during his Italian journey (1786-88). When he returned home he reminded himself of Newton's theory about color, as this was presented in the books available to him, and decided to do the famous experiment with the prism himself. However, having borrowed a prism, his interest and time were then taken up with other things. He did nothing about it until the time came when he was obliged to give the prism back. It was then too late to repeat Newton's experiments, as he had intended, and so he just took a rapid glance through the prism before handing it back. What he saw astonished him, and the energy of his astonishment was so great that it launched him into a research program on color which was to take nearly twenty years. This is what Goethe said about that experience:

> But how astonished was I when the white wall seen through the prism remained white after as before. Only where something dark came against it a more or less decided color was shown, and at last the window-bars appeared most vividly colored, while on the light-grey sky outside no trace of coloring was to be seen. It did not need any long consideration for me to recognize that a *boundary or edge is necessary to call forth the colors*, and I immediately said aloud, as though by instinct, that the Newtonian doctrine is false.[7]

What was the Newtonian doctrine, and why did Goethe believe that what he saw—or rather failed to see—indicated so strongly that it was wrong? To answer this question it will be necessary to begin with a brief account of Newton's experiments with a prism.

NEWTON'S EXPERIMENTS

Newton's work on color also began with a surprise. He made a small circular hole in the window shutter of a darkened room, and passed the beam of sunlight which it formed through a glass prism onto the wall. He observed the colors which formed there, but then he noticed that the image of the aperture on the wall was oblong and not circular, as he would have expected it to have been. Other experiments were then made to explore this peculiarity. In one of these experiments he used a second small aperture in a screen, placed after the prism, to select light of one color only, which he then passed through a second prism. He found that no further colors were formed by the second prism. But he also found that the angle through which the light was deviated by the second prism depended on the color—violet being deviated the most and red the least. He called this the *Experimentum Crucis*, and on the basis of what he saw in it he made an inductive leap to propose the cause of the unexpected shape of the image which he had noticed at first.[8]

Newton's theory was that sunlight is not homogeneous, as had been supposed, but "consists of rays differently refrangible." These rays are all refracted through different angles when the sunlight is incident on the prism, and the colors which are experienced correspond with these different angles of refraction. Thus, the rays which are least refracted produce the sensation of red, whereas the sensation of violet is produced by the rays which are refracted

most. It is, therefore, the separation of these rays by the prism which produces the oblong colored image of the circular aperture. Thus was born the well-known theory that colorless light is a mixture of all the colors of the spectrum, which are separated out by a prism. As such it is known to every schoolboy and repeated by every textbook writer. Yet this is not what Newton thought. In his major work on light he said:

> And if at any time I speak of light and rays as colored or endowed with colors, I would be understood to speak not philosophically and properly, but grossly, and according to such conceptions as vulgar people in seeing all these experiments would be apt to frame. For the rays to speak properly are not colored. In them there is nothing else than a certain power and disposition to stir up a sensation of this or that color.[9]

The trouble is that Newton did often speak of sunlight as being composed of rays of differing colors. Goethe pointed out that this could not be so because every colored light is darker than colorless light, and if colorless light were compounded of colored lights then brightness would be compounded of darkness, which is impossible. But Newton's view that color is a sensation in the observer, and not a physical phenomenon, was quickly forgotten by his followers. One result of selecting only a part of Newton's theory is that what is said about it today is often simply nonsense.[10]

Time and again the myth is repeated that Newton showed by experiment how colorless light contains a mixture of colors, which

are separated by a prism. It is presented as if this were available to the senses and could be observed directly. Yet there is no experiment in which this separation of the colors can be seen directly with the senses. Newton attempted to prove that this is what is happening by reasoning based on experiments. Originally it was an insight for him, and as such it cannot be reached directly by experiment or by logical reasoning based thereon. Subsequently he tried to present it as a consequence of following a definite method. This was the mathematical method, based on geometry, but with experiments replacing verbal propositions. Newton's presentation must be followed with care, and in the spirit in which it was intended; otherwise the unwary reader can easily fall into the trap of believing that Newton had seen with his eyes what cannot in fact be seen directly at all.

What Newton did do, by his combination of experiments and theory, was to replace the phenomenon of color with a set of numbers. In so doing, he fulfilled the aim of the program for the scientific investigation of nature developed by Galileo and others. The introduction of the quantitative, mathematical method into science led inevitably to the distinction between primary and secondary qualities. Primary qualities are those which can be expressed mathematically in a direct way—such as number, magnitude, position, and extension. By contrast, qualities which cannot be expressed mathematically in a direct way—such as color, taste and sound—are said to be secondary. This distinction was subsequently made into a dualism in which only the primary qualities were considered to be real. A secondary quality was supposed to be the result of the effect on the senses of a primary quality, being no more than a subjective experience and not part

of nature. The result of this step was that some of the features of nature which are encountered most immediately in experience were judged to be unreal, just illusions of the senses. One group of qualities, the primary ones, was imagined to be behind the other group, hidden by the appearances, so that a secondary quality was understood when it was explained how it could have arisen from primary qualities alone. In other words, the secondary qualities are really primary qualities which manifest themselves in perception in a manner which is different from what they really are, so that the task of science is to reduce all the phenomena of nature ultimately to such primary qualities as shape, motion, and number.

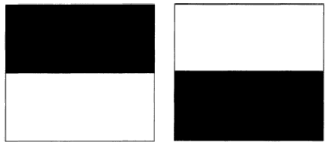
Newton attempted to fulfill this program in two ways in his work on color. Firstly, by showing that different colors are refracted through different angles, he was able to replace the colors by a numerical measurement. Thus he could eliminate color from the scientific description of the world by correlating it with the "degree of refrangibility" (which we now call "angle of refraction"). A series of numbers could then be substituted for the sensory experience of different colors. Secondly, Newton tried to imagine a mechanical model for light, whereby the dispersion of colors by the prism was explained in terms of light corpuscles, or globules, which all moved with the same velocity in a vacuum but different velocities in glass. Thus, according to this model, Newton considered the speed of the imagined light particles to be the objective basis of our experience of color—although he also seems to have considered the size to be an important factor on another occasion, with the corpuscles which caused the sensation of red being bigger than those which caused blue. Whatever the particulars of the model, the important point is that the secondary

quality of color is replaced completely by primary qualities which can be represented quantitatively. This strategy of trying to explain a phenomenon by means of a microscopic model—which is based on images borrowed from the sense-perceptible world—became standard practice in mainstream physics. Newton's own attempt to provide a mechanical model for light was not successful. The model which eventually gained acceptance was the wave model. According to this, light is a wave motion, with different colors corresponding to waves of different frequencies. Once again the phenomenon is reduced to a mathematical magnitude. The model is different, but the result is the same: color is written out of nature.

The Primal Phenomenon of Color

When Goethe saw that the prismatic colors appeared only where there was a boundary, he recognized that the theory of the colors being contained already in the light must be wrong. There must be light *and* dark for the color phenomenon to arise, not just light alone. He investigated this carefully by constructing simple boundaries from which all secondary, complicating factors were removed. Anyone who has a prism can repeat Goethe's observations. Just make a card with a straight boundary between black and white regions, and look at the boundary through the prism with the card in either of the orientations shown in the figure on the opposite page. Holding the prism so that it is oriented like the roof of a house turned upside down, with the edges parallel to the boundary, look through the slanted side facing you toward the card. You will see it displaced downward. In both cases vivid colors are seen parallel to the boundary. In orientation (a) the colors appear in the white region just below the black, with red

nearest to the boundary, then orange, and yellow furthest away from the boundary. In (b) the colors also appear at first to be in the white region, but careful observation (e.g., by placing the tip of a pencil on the boundary for reference) reveals that they are in fact being seen in the black region just below the white. Again, the colors are parallel to the boundary, but with this orientation of the card the colors are blues, with light blue nearest to the boundary and violet furthest into the black. To begin with, it is best to concentrate on the central boundary and ignore the colors at the top and bottom edges of the card.



When observing the phenomenon of color in Goethe's way it is necessary to be more active in seeing than we are usually. The term "observation" is in some ways too passive. We tend to think of an observation as just a matter of opening our eyes in front of the phenomenon, as if it were something that happens to us when visual information flows in through the senses and is registered in consciousness. Observing the phenomenon in Goethe's way requires us to *look*, as if the direction of seeing were reversed, going from ourselves towards the phenomenon instead of vice versa. This is done by putting *attention* into seeing, so that we really do *see* what we are seeing instead of just having a visual impression. It is as if we plunged into seeing. In this way we can begin to *experience* the *quality* of the colors.

But Goethe's encounter with the phenomenon did not stop at this stage of observation. He would then repeat the observations he had made, but this time doing so entirely in his imagination without using the apparatus. He called this discipline *exakte sinnliche Phantasie*, which can be translated "exact sensorial imagination." In this case it would mean trying to visualize making the observations with the prism, and seeing the qualities of the different colors in the right order at a boundary as if we were producing them. This would then be transformed in imagination into an image of the colors with the boundary in the opposite orientation, and then transformed back again. The process can be repeated several times. The aim is to think the phenomenon concretely in imagination, and not to think about it, trying not to leave anything out or to add anything which cannot be observed. Goethe referred to this discipline as "recreating in the wake of ever-creating nature." Combined with active seeing, it has the effect of giving thinking more the quality of perception and sensory observation more the quality of thinking. The purpose is to develop an organ of perception which can deepen our contact with the phenomenon in a way that is impossible by simply having thoughts about it and working over it with the intellectual mind. For example, through working in this way, a relationship between the qualities of the colors may be perceived. Black, violet, and blue begin to be perceived as belonging together, as if there were a unity in these colors which is not perceived at first. The same can be found with white, yellow, orange, and red. Sometimes this relationship between the colors is perceived as having a dynamical quality, even though there is no movement in a physical sense. Thus, what is perceived by the senses as simply different colors

which are separate begins to be perceived more holistically. The colors are perceived belonging together in a unity which is present in the phenomenon but not visible like the colors themselves. If there is unity in the color phenomenon at a boundary, then it is not like something which we may have simply overlooked at first. It is not like a color which we may have missed—as if we could say, "There is red, and there is yellow, and there is the unity over there." It is in fact not visible to the senses (though it may seem to be so), and yet it can be perceived—this point will be taken up in some detail later in this chapter.

Although the unity in the color phenomenon may begin to be intimated by working with the prism in the way described above, it is difficult for it to emerge clearly in these circumstances. This is because the appearance of the colors in this case depends on the peculiar shape of the piece of glass. Goethe believed that this was a complicating factor, and because of this the phenomenon of prismatic colors was not a suitable basis from which to understand the origin of colors. He also believed that there must always be some instance in nature where a phenomenon occurs in the simplest way possible, without any secondary factors to disguise what is essential. He had already recognized from his first observation with the prism that light and dark were necessary "to call forth the colors." So if he could find an instance in nature of the "coming into being" of colors out of light and dark alone, then he would have read the origin of colors directly in nature itself. He called such an instance an *Urphänomen*, which can be translated "primal phenomenon," and he described it as "an instance worth a thousand, bearing all within itself." He saw the proper task of physics as being to find the primal phenomenon for any particular

field of study, and to resist the temptation to try to go beyond it by imagining a hidden mechanism as Newton and others did.

Goethe discovered the primal phenomenon of color in the colors of the sun and the sky. On a clear day the color of the sky overhead is a brilliant blue, which becomes lighter in shade as the angle of vision decreases towards the horizon. But if we were to go up a mountain, the color overhead would progressively darken until it became violet. If we could go higher still, it would darken further until it became black. When we look at the sky overhead, we are seeing darkness through the atmosphere which is illuminated by the sun. The quality of the blue we see depends on the thickness of the atmosphere through which we are seeing the darkness of outer space. The greater the thickness of the atmosphere, the lighter the shade of blue. Goethe recognized that the role of the atmosphere here is to be a light-filled medium because it is illuminated by the sun. So when we look at the sky we are looking at dark through light, and the effect of this is to lighten the dark progressively into lighter shades of blue as the proportion of the light-filled medium increases. Thus the origin of blue is the lightening of dark which occurs when dark is seen through light. In this way Goethe learned to see the "coming into being" of the various shades of blue in the phenomenon itself.

The origin of red and yellow can be discovered in the changing color of the sun. When it is overhead on a clear day the sun is yellow, and it darkens in color towards red as it moves closer to the horizon at sunset. In this case we are looking at light through the atmosphere, and the role of this medium is now to darken what is seen in proportion as its thickness increases. If we were

to go higher up, the sun would become whiter as the atmospheric thickness decreased. Thus the origin of yellow, orange, and red is the darkening of light which occurs when light is seen through dark. Here also Goethe learned to see the "coming into being" of the colors in the phenomenon itself, so that from this "instance worth a thousand, bearing all within itself" he could understand how they arise out of light and dark exclusively.

Now we can read the colors of the sun and the sky in the prismatic colors. It is well worthwhile doing this by exact sensorial imagination, instead of just following it in the verbal-intellectual manner. Beginning with the color of the sky, we can visualize the change in quality of the color from black through to pale blue as the thickness of the atmosphere increases. Then we can visualize the colors formed with the prism when the boundary is in orientation (b). We can see the same order in the qualities of the prismatic colors as in the colors of the sky. The sequence from black to violet to pale blue now corresponds to an increasing thickness of cross-section of the prism which we are looking through. Since we have noticed before that these colors are seen in the black region, we can now recognize that what we are seeing here is different degrees of the lightening of dark. Repeating this exercise in imagination with the color of the sun, and the prism with the boundary in orientation (a), we can again recognize the same order in the qualities of the colors in the two phenomena. This time we are seeing the darkening of light. The colors deepen from yellow to orange and red as the thickness of the atmosphere, or the cross-section of the prism, increases. The prism plays the same dual role of the medium as the atmosphere does, depending on whether it is light which is seen through dark, or vice versa. We

may not know in detail yet how it comes about that we are seeing dark through light or light through dark with the prism, and we cannot go further into this here, but what we have done is sufficient to illustrate Goethe's way of learning from the phenomenon itself in such a way that it becomes its own explanation.[11]

Although the practice of thinking the phenomenon concretely by exact sensorial imagination is irksome to the intellectual mind, which is always impatient to rush ahead, its value for developing perception of the phenomenon cannot be overestimated. It has been mentioned already how this discipline can be instrumental in perceiving a phenomenon holistically. The practice of it, as in the case just described, shows how this comes about from the demand which it makes on us to visualize the phenomenon comprehensively. It also shows how the demand to produce the phenomenon for ourselves helps thinking to enter into the coming into being of the phenomenon, instead of analyzing what has already become. What Goethe discovered in this way was a dynamical polarity in the color phenomenon. As well as the unity within the quality of the colors in each orientation of the boundary, which is a real relationship between the colors, there is also a unity between the two different color phenomena. This is the unity of a polarity, like positive and negative electric charge. Because one and the same boundary can be in two different orientations with respect to the prism, these two color phenomena are really inseparable. We may think of them separately, and in any particular case we must choose one and not the other because we cannot have both simultaneously at the same boundary. But they are not essentially separate from each other because each one

determines the possibility of the other, i.e., if one is possible then the other must be too. So this polarity is essentially holistic and not analytical. We can begin to experience it as such in the colors of the sun and the sky, as well as with the prism, by working intentionally with exact sensorial imagination instead of with the verbal-intellectual mind.

Goethe described this polarity as "the deeds and sufferings of light," a poetic expression which is as precise in the science of quality as any mathematical expression in the science of quantity. But "the deeds and sufferings of light" is already a second-degree polarity. The primary polarity is the unity of light and dark. When we think of "light and dark" with the verbal-intellectual mind, we interpret it analytically—we have a mental impression of "light" and "dark," each on their own, joined together externally by "and." But this misses the fact that we cannot have the one without the other—it is as if the possibility of each one is determined by the other. There is a wholeness in the boundary itself which we usually do not notice. It is true of all opposites that they mutually determine each other, and hence that there is a unity in their opposition. Aristotle said that the knowledge of opposites is one. The trouble is that it is not one for the verbal-intellectual mind because of its analytical character. The wholeness of polarity can only be perceived when the mind works in a more holistic mode; otherwise it is only an abstraction. The practice of exact sensorial imagination is a door to this mode. This will be discussed further below.

It is possible to have both "poles" of the color phenomenon present simultaneously by making a card with a broad white band on a black background:

If we now imagine the white space shrinking in the vertical direction so that the two horizontal boundaries come closer together, a point will be reached where the two polar phenomena meet and overlap. We can find out what happens when they do by making a card with a narrow white band on a black background:

Where they meet we see green, for the first time, and there is now something like the "spectrum of light" which Newton described—the pattern of light and dark on this card being the same as for a narrow slit in a screen illuminated from behind.[12] But this has been reached in a very different way from New-tons. By following the coming into being of green in this way, Goethe was able to recognize that the idea of a spectrum of light was an error of judgment, arising from the fact that "a complicated phenomenon should have been taken as a basis, and the simpler explained from the complex." This error of judgment is a consequence of trying to understand the origin of the phenomenon in terms of the finished product. The Sufi poet and philosopher Jalaluddin Rumi described this approach in general as trying to "reach the milk by way of

the cheese."[13] Following this analogy, the naive interpretation of Newton's theory of the prismatic colors, described above, amounts to the assertion that cheese comes from milk because cheese is already there in milk. The more sophisticated version, which Newton himself advocated, is the equivalent of saying that a disposition towards cheese exists in the milk, but it only becomes the cheese I experience when it enters a human digestive system. Goethe's approach, on the other hand, is the equivalent of trying to understand cheese by following through the process by which it is produced.

When the prismatic colors are understood in Goethe's holistic way, the quality of each color becomes something which is intelligible in itself and not just an accident. In Newton's account of the origin of the colors there is no reason why the color "red" has the quality of red, or why "blue" has the quality of blue, or why the colors are in the order observed and not in some other order. The intelligibility of the colors in themselves disappears in the analytical approach, and what is left seems to be merely contingent. It is no answer to be told that the order the colors appear in is the numerical order of their wavelengths, and that red has the quality of red because its wavelength is seven-tenths of a millionth of a meter, whereas violet has the quality of violet because its wavelength is four-tenths of a millionth of a meter. There is simply no way in which these qualities can be derived from such quantities. But it is very different when the colors are seen comprehensively in Goethe's way. The order of the colors is now necessary instead of contingent, and hence the quality of each particular color becomes intelligible in itself instead of appearing accidental.