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Goethe's Way of Seeing:
The Science and the Poetics of Perception

By Hyatt Carter

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Norwood Russell Hanson, a philosopher of science, offers for our consideration this tantalizing thought: "There is more to seeing than meets the eye." The truth of this was vividly brought home to me when I discovered, only a few weeks ago, that Goethe, the great German writer, developed a way of seeing that can be a powerful addition to everyone's perceptual experience. With the advent of spring and its spirit of renewal, the time seems ripe for finding new ways of seeing, and Goethe offers us both a way, and the inspiration, for doing so.

Most people know that Goethe was a consummate poet and dramatist, but not so many know that he also accomplished significant work in science, and that he rivaled da Vinci in the versatility of his accomplishments. [1] While some of Goethe's discoveries have always attracted, and continue to attract, interest, there is perhaps even more interest in his Method of doing science, or his way of seeing. [2]

In his scientific studies, Goethe developed a way of observing nature that is so subtle and innovative that it amounts to creating new perceptive powers. As he put it, "Every new object, well contemplated, opens up a new organ of perception within us."

In his essay "Elements and Ethers: Modes of Observing the world," the German biologist Jochen Bockemühl brings a new dimension to Goethe's Method by seeing it as a fourfold process that he interprets in terms of the four traditional elements: earth, water, air, and fire. Nigel Hoffmann, a philosopher who teaches at the University of Newcastle in Australia, builds on the work of Bockemühl by putting it into practical application, and by bringing to light the link between art and science that is always present in Goethe's scientific studies.

This article will draw heavily on the thought of these two men as we explore Goethe's way of seeing. But first, to show the power of Goethe's Method, I will present a brief sketch of four of Goethe's scientific discoveries.

Goethe's Discoveries

Fossils

Goethe was the first to see that fossils bear a crucial relationship to the strata of earth where they are discovered, and that the organisms, of which the fossils are remains, lived during the geological periods when those strata were formed. He prophetically concluded from his studies that "the time will soon come when one will no longer just throw fossils all together but will classify them according to the world epochs."

Bone of Contention

The scientific community in Goethe's day was in agreement about one of the physical characteristics that distinguish humans from apes and other mammals: a small bone in the upper jaw called the intermaxillary. Humans were the only mammal in which this bone was not present. Goethe's way of seeing enabled him to discern this bone in the skulls of human anatomical specimens. Although some scientists came around to Goethe's way of seeing when they read his argument and looked at the evidence he presented, many stubbornly refused to validate his discovery. There's a lesson here: when opinion ossifies into dogma, vision can ossify into blindness.

To his lasting honor, and as a tribute to his power of observation, the intermaxillary bone, or *os intermaxillare*, is also called the "Goethe bone."

Newton Is Wrong

Goethe's way of seeing enabled him to discover that Newton was mistaken about one of his basic ideas in optics. From his experiments with a prism, Newton's view was that light contains the seven colors of the spectrum and that the prism only makes *visible* what is invisibly contained within light itself.

However, when Goethe first looked through a prism, he was taken aback at what he saw and he immediately exclaimed, "Newton is wrong!"

Looking at a white wall through the prism, Goethe saw no colors whatsoever; but turning his gaze to the window where the dark frames around the window panes stood out against the bright sky outside, along the edge of the frames, at the intersection of darkness and light, colors suddenly blossomed before his eyes. And, as he continued to investigate this, he came to clearly see that prismatic colors arise from the creative interplay of darkness and light. Colors were thus the creation of what is perhaps the most

fundamental polarity, with darkness shining every bit as darkly as light shines brightly.

With eyes made keen by his method, Goethe also discerned an archetypal example of this that is right before our eyes every day in the natural world. At dawn or dusk, with the rising or setting sun, the horizon shines with the warm colors of the spectrum (red, orange, and yellow) while in full daylight the sky overhead shimmers with the cool colors of blue, indigo, and violet.

At dawn, we see light shining through darkness, as the sun shines through the darkness of the earth's atmosphere, whereas, in the full light of day we see darkness shining through light as the darkness of outer space shines through the sunlit sky, light blue at lower elevations, with the blue darkening the higher up you go. Astronauts, in orbit beyond the earth's atmosphere, see only the darkness of space.

In light of this, it could be said, to slightly rephrase Paul's verse in Corinthians, that we see as through a prism, darkly *and* lightly.

The Metamorphosis of Plants

Goethe was a natural born holistic thinker and he coined a word for this kind of thought: *Ganzheitsdenken*—thinking your way into the wholeness of things. Thinking his way into what constitutes the wholeness of a living plant, Goethe came to see a rhythm of creative *movement* pulsating in the plant.

The unity of the plant is one complete formative *movement*—and the one form presiding throughout this movement is no static form, but a dynamic form that is mobile, temporal, and, while invisible to the senses, can become visible to the imagination.

This formative movement is *metamorphosis*, which means "transformation."

But metamorphosis, as Goethe used the word, is not simply transformation, but an *upward* transformation.

Goethe saw in the developmental sequence of an annual flowering plant a progressive enhancement of expression. In his words:

"Regular metamorphosis may also be called *progressive* metamorphosis: it can be seen to work step by step from the first seed leaves to the last formation of the fruit. By changing one form into another, it ascends—as on a spiritual ladder—to the pinnacle of nature: propagation through two genders."

This *movement* of metamorphosis will be discussed in more detail later in this article, in the section about the Water Element.

At this point I will also mention that the content of this section will suggest to some that Goethe has affinities with process thought. Indeed, some aspects of Goethe's thought are so suggestive of this that I have traced, in an endnote [3] substantial links between Goethe and the premier process philosopher of the twentieth century, Alfred North Whitehead.

With all this in place, I will now turn to Goethe's Fourfold Method and its first element: Earth.

Earth Element

The mode of observation used by science is empiricism—using the senses, especially sight, to see reality as it really is, objectively, and not guided by subjective bias.

But whereas materialistic science tends to employ an *assertive* empiricism that stands completely apart from the object of investigation, Goethe called his method "a *gentle* empiricism" (*eine zarte Empirie*) that is so receptive to the object, and so participates in the life or being of the object, that it "makes itself utterly identical with the object."

As an object of study in this exercise, I suggest a small annual plant flowers and bears fruit. In the Earth Element phase, the focus is on the external aspects of the plant.

To begin: let it be *as if* you are seeing this plant for the first time, and open yourself to a fresh *first impression* of the plant. Linger with that impression for a while, release it, and let it meander into memory.

Now, simply look at the plant, but with the eyes of an artist. With an active gaze, take in the various contours, the colors, the surfaces, the shapes. What does the outer appearance really look like? In terms of external appearance alone, what is the plant expressing to the world, to you?

Run your fingertips lightly along the surfaces of the plant. What do they feel like? What is the scent of the stem, the leaves, the flowers? If you wish, you can taste a leaf, a petal of a flower, or, if present, the pollen.

Relax your eyes, allow your eyelids to almost but not quite close, and gaze at the plant in soft focus. Close your eyes and form an idea, or a mental image, of what the plant looks like. Do you seen the image so clearly that you could draw a picture of the plant, but *without looking at it*?

As perception in this mode deepens, we begin to see that what is lacking is the temporal dimension of the plant.

We can, of course, talk about the organic processes of a plant, but Bockemühl reminds us that descriptions of the temporal qualities of a plant (such as "it blossoms in May") easily become *established*—the German word he uses is *festgestellt*, which literally means "made solid."

He goes on to say, "It slowly becomes clear to us that we come to *firm* conclusions, that we are always *limited to the surface* of things and see them as *separate*, exactly because the qualities of *solidity*, *impenetrability* and *separateness* are rooted in our cognitional attitude itself. This attitude can be characterized, following Maier, as having the quality of the earth element."

And so we turn now to the second phase, or Water, the time dimension of the plant, and its inner dimension, where Goethe will help us to see with the eyes of imagination.

Water Element

To observe a living plant, even on a number of successive occasions, is to see only a series of "snapshots" of what is really a seamless flow, a metamorphic process of continuous change.

As they unfold in temporal sequence, the various parts of a plant—stem, leaves, flowers—are the expressions of what Hoffmann calls *one generative movement*.

It is this *one generative movement* that is the fundamental and dynamic nature of the plant.

Just as the invisible energy of a whirlpool is made visible by the water wherein it swirls, so is the *one generative movement* made visible by the external form of the plant itself.

Although we can see the plant, the *movement* itself cannot be perceived by the senses; however, we can directly experience it by re-creating, in imagination, the whole life of the plant.

This, too, is a mode of observation, but it is a *new* way of seeing and Goethe calls it "exact sensorial imagination" (*exakte sinnliche Phantasie*).

This kind of imagination, far from being a flight of fancy, is *exact* and *sensorial* because it is based on the precise observations of the Earth phase.

An exercise that will help you see this movement is to cut the leaves from a plant and then place them in sequence, for comparison, as in the illustration below. By following the sequence of changes, you become aware, as Bockemühl puts it, "of a sequential change in the forms—a *movement* which is not present for the senses as movement in the normal sense."

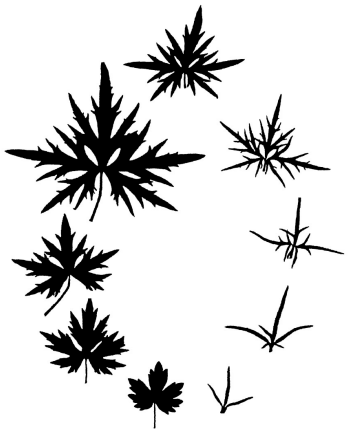

Figure 1
Leaves taken from the common buttercup (*Ranunculus acris*).
Ordered from bottom of stem (lowest left) to top (bottom right).

And so, beginning with the sprouting seed, we create, in imagination, a moving picture of the development of the plant through stem, branches, leaves, flower, fruit, and new seeds within the fruit.

As we run this moving picture over and over, and, as Goethe suggests, both forward and backward, we begin to see it one flowing process: the *movement* of metamorphosis.

And this brings us to why this is called the Water phase.

To experience the *movement* itself, the mind must become so fluid that it can flow like water and, also like water, conform to whatever it touches. As Hoffmann says, "Exact sensorial imagination does this by molding itself to one form and then 'flowing' to the next so that the particulars are 'dissolved' into one fluid movement."

Air Element

Like water, air is a fluid, but it is lighter and more insubstantial than water—you cannot see it or touch it. The purer the air, the more transparent it is. The lightness or buoyancy of air supports beautiful cloud formations and the flow of air can be felt in every breeze. In the airy mode of observation we welcome these qualities of air into consciousness.

We have progressed from a mental image, a snapshot or a still life of the plant, to moving pictures from which we learned to glimpse the essence of *movement* itself.

Each successive phase represents a higher "distillation" of whatever phenomenon it is that we are observing. The images we perceive reflect an increasing lightness, in both senses of the word, and intensification.

Now, with the element of air, we begin to perceive *meaning* in the images, to see them as what Goethe called "gestures." A gesture is a movement that expresses meaning.

To give you an idea of the gestures to be perceived in plants, consider the following by George Trevelyan:

"In the workings of nature there seems to be a lifting of inert substance towards greater lightness and a more etherealized state. The living plant makes its gesture of opening its chalice towards the light, lifting dark substance towards a realm of higher frequency and offering a point where ethereal formative forces can stream down into the earth plane."

We enjoy a natural intimacy with the air element through the breathing of air—our breath—and the rhythms of breathing, inhalation and exhalation, mirror the rhythms of expansion and contraction that, as we will see in the next section, Goethe saw as active in the growth of a plant. The mode of cognition in this phase, according to Hoffmann, is "inspiration," and when we look at the etymology of this word we find that it derives from two Latin roots that mean "to breathe into."

Fire Element

Imagine a candle flame and note how the flame rises in the air. Seemingly free from gravity, the flow of fire is always up, up, and away . . . and, like church steeples, fire reaches with fingers of flame for the heavens above. Imparting both warmth and light, fire burns with sheer intensity concentrated in the still point of the rising flame.

Observation in this phase will be in the intuitive mode, what Goethe called *anschauende Urteilskraft* or "intuitive judgment" or, as one writer translates it, the "perceptive power of thought."

The object here is to perceive archetypal patterns, primal phenomena—*Urphänomen*, to use Goethe's word—and to experience what fundamentally constitutes the wholeness of the plant. But, as Hoffmann says, "The whole is nothing substantial or nothing actualized. It is pure potentiality or potency." To perceive this is to see the *movement* discerned in the water stage at an even higher level of distillation.

As an example of primal phenomena, one gesture in the growth patterns of plants that Goethe was the first to see was a dynamic polarity that he saw as an archetypal creative principle. Writer Ernst Lehrs describes it thus:

"Goethe recognized a certain rhythm of expansion and contraction, and he found that the plant passes through it three times during any one cycle of its life. In the foliage the plant expands, in the calyx it contracts; it expands again in the flower and contracts in the pistil and stamens; finally, it expands in the fruit and contracts in the seed."

Among the many variations on this theme of expansion and contraction, I'll mention only one: the rise and fall of barometric pressure, which Goethe saw as the "breathing" of our planet, thus linking the two elements, earth and air.

As we experience the four elements one after the other—earth, water, air, and fire—we not only come to see the plant in a new way, but we also achieve a new way of seeing.

To sum up this section, Henri Bortoft, a physicist and philosopher of science, puts it as felicitously as it can be put:

"When we try to think concretely with the plant we participate in the doing of the plant. This doing, which *is* the plant, is the very being of the plant, as we can discover for ourselves when we think *with* the plant, instead of looking *at* it and thinking *about* it. In this way the movement of our thinking participates in the formative movement of the plant, so that the plant 'coins itself into thought' instead of into material form as in outer nature."

The Metamorphosis of the Scientist

Frederick Amrine, a university professor who has published extensively on Goethe's scientific works, makes what seems at first a startling observation but, once understood, it seems as obvious as a Zen koan: whenever there is progress in science, "It is not the *data* that change in a 'Gestalt switch.' Rather, it is *we* who change." And *what* changes is that we develop *new ways of seeing*.

An example provided by Ronald Brady will help to clarify this. When you observe the following figure, what do you see?

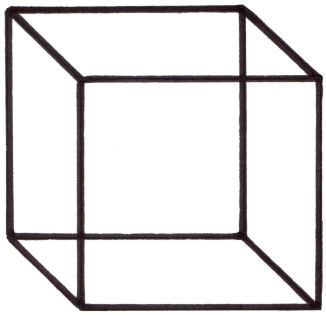

Figure 2

There is a deliberate ambiguity built into this figure. Looked at in one way, it appears as a cube slanting down to the right. But, if you gaze at it for a while, it will suddenly do a flip and appear as a cube slanting up to the left. With sufficient practice you can make the *two* cubes oscillate back and forth every few seconds and, with further practice, and patience, you can even come to see the figure not as a box, but merely as lines all on the same flat plane.

The point to notice here is that the figure itself does not change. When, then, does change? As Brady, in his essay "The Idea in Nature," explains:

"These differing configurations are not added by thought after the object is perceived but are intended by the perceiver in the act of perceiving. The observer who attempts to make the choice of cubes voluntary will find that to exchange one cube for another no further change is required than thinking (intending) the other cube. Simply look at the cube presently seen and think or imagine the alternate cube until it appears. The shift should take place in a few seconds. Only an intentional change is required to produce the difference, for the alternate cube represents an alternate set of relations rather than a new sensible report.

"The viewer makes these shifts by assigning the spatial relations to the elements in the diagram—particularly those of depth. After all, we must take the elements of the perceptual field to be at specific depths to reach this or that figure. Even the flat pattern presents no exception, for we can come to it only by seeing all elements on the same plane. Since, to see a figure, one must grasp the spatial relations of the same, seeing is also cognizing. Cognition in this sense is not a proposition about what is perceived but an activity that actualizes the perception. *Each act of seeing is necessarily an act of understanding*. The grasp of geometric relations that we use to understand the cube, once seen, is the same one that we use to see it in the first place. We do not perceive and then bring forward a concept to understand. We focus our understanding to bring forth a perception."

Now, in your mind's eye, hold for a while, and compare, Figure 1 (the buttercup leaves) and the cube in Figure 2. Do you now see that both represent a series of transformations, or the movement of metamorphosis?

With cultivation and practice, and through active participation in these movements of metamorphosis, Goethe found that he was himself transformed, because the observation of metamorphosis *gives rise to* metamorphosis of the observer. Indeed, this is the whole point!

"For Goethe," as Amrine says, "the experiment is not like a single, practical syllogism but rather like artistic practice directed towards the refinement of one's perception over time. Again we see that the primary aim of science, as Goethe understands it, must be self-development, *the metamorphosis of the scientist*."

There is an *enhancement* of understanding, an *intensification*, a *heightening*, what Goethe calls *Steigerung*. The verb form of this German word is *steigen* which means "to climb, increase, ascend,"—that is one reason I used, and italicized, the expression "gives rise to" two paragraphs above.

We have seen this same heightening, or *Steigerung*, before, in the developmental process of the a plant and its many metamorphoses from first sprouting, then stem, leaves, and to its fulfillment in flowers that blossom in beauty.

Imagine someone who has never seen a flowering plant who closely follows the process of growth for the very first time. From what he sees in the plant up until the time just before a flower blooms, must it not seem like a miracle when he goes out one morning to find something utterly new that the plant has given rise to during the night: the splendor of an open blossom. Ah!—would not wonder thrill in his veins at such a marvel!

As the blossom is to the plant, so is the moment of epiphany to the modes of observation that have preceded and prepared the way for it.

Steigerung!

The Varieties of Perceptual Experience

Goethe's holistic thinking is reflected in his searching for not just one way of seeing a particular object, but many different ways. These modes of observation, or ways of conceiving things, are, to use the term that Goethe coined, *Vorstellungsarten*. [4] Together, these different modes of observation insure balance, do justice to the plurality, depth, richness, and complexity of nature, and give rise to a wholeness in perception that would otherwise be missed.

To give you some examples of *Vorstellungsarten*, Dennis L. Sepper notes that Goethe's magnum opus, *Zur Farbenlehre*, "is suffused with their presence. As we read through it we see the continual emergence, interplay, adaptation, ebb, and reemergence of—to name some of the chief ones—the genetic and the atomistic, the dynamic and the mechanical, the concrete and the abstract, the mathematical and the physical, the material and the spiritual ways of thinking and conceiving things."

In contrast to Newton, and the scientific community of his day, whose *Vorstellungsarten* he saw as atomistic, mechanical, and mathematical, Goethe characterized how own way of conceiving as genetic, dynamic, and concrete.

This method can be seen at work in how Goethe described, in a letter to a friend, how he went about his optical studies:

"The material is, as you know, extremely interesting and the elaboration a mental exercise of a sort that I perhaps would not have gained in any other way. To grasp the phenomena, to fixate them into experiments, to order one's experiences, and to come to know all the ways in which one might view them; to be as attentive as possible in the first case, as exact as possible in the second, to be as complete as possible in the third, and to remain many-sided enough in the fourth, requires that one work through one's poor ego in a way I had else hardly thought possible." [5]

Working with a method such as this, more comprehensive truth about something may be revealed by looking at it from various perspectives, and enhancements of understanding can sometimes be achieved by seeing as if through the eyes of someone whose mode of observation, or way of conceiving may differ from you, even to the point of being exactly opposite.

To be comprehensive, the truth, as Sepper points out, "must be approached from all its many sides. *A priori* there is no single, authoritative way to approach a given phenomenon; and a single human being, plagued by many kinds of one-sidedness, would scarcely be able to produce a science on his own. Thus pluralism is not just one among many desiderata but an absolute prerequisite for a constructive and progressive science, whose goal is less to produce a set of true propositions and indoctrinate scientists into their intention than to amplify the human experience of nature. . . . Goethe frequently pointed out to friends that his scientific work had made him many-sided by compelling him to entertain different points of view, some of which he was able to incorporate into his own; and by practicing sciences he gradually developed 'organs' for experiencing and understanding that originally he had not possessed."

And so Goethe here exemplifies once again the movement of metamorphosis that results in a heightening or enhancement of his perceptual powers.

The idea of metamorphosis is central to Goethe's thought and finds its fullest expression in a work he titled *The Metamorphosis of Plants*. In light of what we have seen, he could just as well have called it *The Metamorphosis of Goethe*.

As a closing "gesture" for this essay, I present for your contemplation the following random markings in black and white. [6] Gaze at it for a few moments and you may be surprised by what emerges.

Figure 3

Do you see? What happened, exactly, in the instant of transformation from randomness to order?

Endnotes

1. From the back cover of Goethe's book, *Maxims and Reflections*:

Throughout his long, hectic, and astonishingly varied life, Johann Wolfgang von Goethe (1749–1832) would jot down his passing thoughts on theatre programs, visiting cards, draft manuscripts, and even bills. Goethe was probably the last true "Renaissance Man." Although employed as a Privy Councilor at the Duke of Weimar's court, where he helped oversee major mining, road-building, and irrigation projects, he also painted, directed plays, carried out research in anatomy, botany, and optics—and still found time to produce masterpieces in every literary genre.

His fourteen hundred Maxims and Reflections reveal some of his deepest thought on art, ethics, literature, and natural science, but also his immediate reactions to books, chance encounters, or his administrative work.

And this from *The Columbia Encyclopedia*:

Increasingly aloof from national, political, or even literary partisanship, Goethe became more and more the Olympian divinity, to whose shrine at Weimar all Europe flocked. The variety and extent of his accomplishments and activities were monumental. Goethe knew French, English, Italian, Latin, Greek, and Hebrew and translated works by Diderot, Voltaire, Cellini, Byron, and others. His approach to science was one of sensuous experience and poetic intuition.

An accomplished amateur musician, Goethe conducted instrumental and vocal ensembles and directed opera performances in Weimar. Goethe's exquisite lyrical poems, often inspired by existing songs, challenged contemporary composers to give their best in music.

2. Frederick Amrine and Francis J. Zucker, in their Introduction to *Goethe and the Sciences: A Reappraisal*, have this to say about the stature of Goethe's scientific studies:

In his scientific work, Goethe simultaneously stands within modern science, seeks to expand it, and stands opposed. This complex relationship is perhaps one reason why Goethe's scientific writings have remained a subject of perennial interest, while the work of so many of his contemporaries has been saved from oblivion only by the curiosity of historians.

Goethe certainly considered himself a scientist in the fullest sense of the word: late in life, he even claimed that he hoped and expected to be remembered more as a scientist than as a poet. He participated actively in many of the important scientific debates of his day, performed and promoted research, corresponded with his great contemporaries in science, and published voluminously in numerous fields, including the history and philosophy of science. While some parts of his work (notably his meteorological and geological studies) have never found favor, others, such as his work in physiological optics, animal morphology, and botany were widely accepted — even hailed — by the scientific "establishment" of his day, and led directly or indirectly to further advances. A number of important scientific works were dedicated to him. For these reasons alone, Goethe the scientist would be worthy of continuing historical study.

Yet surely Goethe's role in the history of "mainstream" science is not sufficiently large or important to account for the small mountain of secondary literature that his work has called forth. Granted that his stature as a literary figure has played a part, even this cannot account fully for the unbroken attraction of his scientific writings. After all, Newton's theological speculations (a roughly analogous case) have not elicited anything like the number of studies inspired by this aspect of Goethe — perhaps 10,000 in all. The reason for the attraction lies elsewhere: it is that Goethe sought to do science in a different way.

3. Morphology, the science of organic form, was founded and named by Goethe. In "The Purpose Set Forth," a short essay about this new science, he makes a distinction between two ways of conceiving the living forms of nature, Goethe articulates a "process" view of nature that clearly anticipates some elements in the thought of Alfred North Whitehead (1861-1947), the founder of process philosophy.

4. As it may help to clarify the meaning of Vorstellungsarten to see the word used by various writers, here is a selection I culled from my recent reading:

from *Goethe's Way of Science*:

Here is the ground from which all our Vorstellungsarten—all scientific "paradigms"—arise. 47

from *The Wholeness of Nature*:

What Goethe discovered as a result of his encounter with Schiller, with his Kantian background, was the active role in all acts of cognitive perception of what he called a Vorstellungsart [singular form of the word], a way of conceiving, or a mode of illumination, whereby the world becomes visible in a particular way. He realized that different Vorstellungsarten would result in the world being illuminated differently, and hence being disclosed in different modes. 120

from *Goethe and the Sciences*:

Concomitantly he explored and tried to incorporate into science the variety of ways in which phenomena can be experienced and conceived (what he called the Vorstellungsarten — 'modes of conceptualization'). Accordingly the major aim of natural science could no longer be to establish the truth of an hypothesis, e.g. by showing there is an (approximately) exact fit between prediction and experimental result in a few "crucial" cases, but rather to strive for overall fidelity in one's way of seeing (theoria) to the variety of phenomena conceived as comprehensively as possible. 177-78

In response he began to note with avidity and assiduity the variety of ways of (re)presenting the world, the Vorstellungsarten, for which the history of the natural sciences is the richest source. 185

from *Goethe contra Newton*:

Among the latter he included the Vorstellungsarten, the ways of conceiving things, which he had characterized as the attempt to bring many objects into a relationship that, strictly speaking, they did not have with one another. 91

5. Note how the fourfold theme finds expression in this paragraph. It also finds expression in this excerpt from Goethe's *Theory of Colors*:

"An extremely odd demand is often set forth but never met, even by those who make it: i.e., that empirical data should be presented without any theoretical context, leaving the reader, the student, to his own devices in judging it. This demand seems odd because it is useless simply to look at something.

"Every act of *looking* turns into *observation*, every act of observation into *reflection*, every act of reflection into the *making of associations*; thus it is evident that we theorize every time we look carefully at the world.

"The ability to do this with *clarity of mind*, with *self-knowledge*, in a *free way*, and (if I may venture to put it so) with *irony*, is a skill we will need in order to avoid the pitfalls of abstraction and attain the results we desire, results which can find a living and practical application."

6. This picture is from Henri Bortoft's excellent book, *The Wholeness of Nature: Goethe's Way toward a Science of Conscious Participation in Nat*ure, page 50.
It may be of interest to learn, as Bortoft points out, that when Galileo first looked through his telescope at the surface of the moon, he saw not mountains and valleys, but something similar to what is initially seen in the above image. Only when his gaze became cognitive through an organizing idea did he glimpse mountains and valleys.