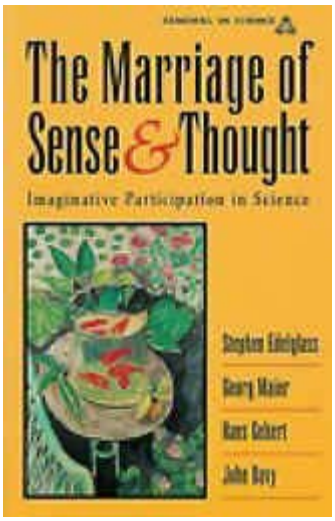

A READER'S JOURNAL

The Marriage of Sense and Thought
by
Stephen Edelglass, Georg Maier, Hans Gebert, John Davy

Imaginative Participation in Science
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A Book Review by Bobby Matherne ©2007

There is a fairy tale about a King who was going to get new clothes, a completely new Royal outfit with everything from underwear to the Royal robe. The material to be used was *pseudo-phenomenal* cloth — it was so rich and fine that only a King could afford it. The clothiers gave the King a sophisticated barrage of descriptive words which culminated in the King's unknowingly parading through his subjects completely nude. No one in the crowd of subjects lining the parade route said anything, until one small voice was heard from the crowd, "The King has *no* clothes on!"

Materialistic science has been clothed in "pseudo-phenomenal" cloth for hundreds of years now, and the authors of this fine book raise their small voice to cry aloud to all who are wondering what is wrong with King Science, "The King is naked!" The clothiers of Science have built its Royal garments of pseudo-phenomenal cloth, words which describe things and objects which *no one* can see, *no one* has ever seen, and *no one* will ever see. Why? Because the objects they discuss, like the King's New Clothes exist *only* in the words used to describe them. They are convenient fictions used to create the illusion of objects where in fact there are none. Like the subjects stationed alongside the road of the King's route, we inwardly have felt somehow cheated or deceived in our heart of hearts, but we have held our silence. With the King and his courtiers proclaiming how fine his new clothes are to the world, who would dare complain aloud that the King could have been deceived for all these years? Edelglass, Maier, Gebert, and Davy are like the small boy in the fairy tale yelling to all that King Science has no clothes on.

As a physicist, I cut my eye teeth on pseudo-phenomenal thought. In my Senior Project, I built a field emission microscope and took images of atoms of tungsten on the tip of a very sharp needle I had crafted. No one was going to tell me that atoms were not real. I had taken a photo of them, or so I thought, deluded as I was by the pseudo-phenomenal cloth of the science I had been studying. Am I saying that there are no atoms? No, what I am saying is that atoms are not things — they are as invisible as the King's new clothes. The photo I had taken and all anyone can take a photo of is the *effect* that arrays of atoms make when beams of electrons are bounced off or extracted from them. Atoms are non-things, electrons are non-things, but if we bombard the former with the latter, we can produce photos which reveal some evidence of structure which, if we wish, we can point to and say, these bumps here are atoms. But the bumps, rightly understood, are merely patterns created by one kind of process (electrons) interacting with another kind of process (atoms).

The original title of this book was "Matter and Mind" and as I was reading this book, I was also reading another book with those words in its title, Mind, Matter, and the Implicate Order by Paavo Pylkkänen. The "implicate order" refers to a reality postulated by David Bohm in which there are *no things*, but solely

process, a moving implicate order, which is enfolded upon itself. What we experience as things are only salient points of the *implicate* order which have unfolded for us as an *explicate* order. What Pylkkänen describes in his book is how science since the discovery of quantum effects has been forced to admit the absence of its clothes and is scurrying to provide some coverage. Edelglass etal have applied their knowledge and writing skills to produce a book in which each chapter is an enfolded unity. We read the explicate order of the printed book which is an enfolded product of the authors.

> **[page ix, Preface by Edelglass] This book was truly coauthored. It is the result of a culture of work that values conversation as a means of making scientific progress. Its conception as a whole and in its individual chapters was a joint effort that evolved over many years. The content of each chapter was planned by the group of authors, written by one of the group, and then rewritten by another after further discussion. And, often, it was rewritten again. Consequently, this book does not consist of separately contributed chapters. To the extent that we have been successful, it is a coherent whole. It was a wonderful experience for me to work in a community where individual gifts contribute toward a totality.**

In the Preface, we read where Edelglass was brought to examine the very foundations of science by his study and teaching of quantum mechanics.

> **[page x, Preface by Edelglass]A few years later, while teaching a graduate course in quantum mechanics, I finally saw the fallacy in thinking that science had the last word concerning the nature of reality — that somehow philosophical questions came in the form of trying to understand the results of science, after the fact so to speak, while the presuppositions upon which science was built were left unexamined and taken for granted. Scientific methods and the contemporary scientific paradigm had previously had an aura of logical necessity whose transcendence seemed, until that time, unthinkable. With this realization I felt freed to explore new possibilities. . . . I undertook a search to discover if a science that bridged the gulf between inner and outer experience was possible . . .**

Studying and working as a physicist I found myself learning things that no one I knew, outside of other physicists, cared about. It seemed clear to me at the time that I was interested in things that were scientific, and those other people were not interested in scientific things. I was like one of the clothiers of the fictional King, and only the other clothiers and the King who paid for his new clothes were interested in what I was learning about making and designing the King's new clothes. Meanwhile my other friends were more interested in things like friendship and *that* I was sure couldn't be described scientifically.

> **[page 1] When friends meet, they smile. They greet one another warmly and are glad to have met again. These sentences describe a common event in a simple and comprehensible way. But they are not "scientific." The warmth of a greeting cannot be measured by a thermometer, nor is the accompanying "gladness" observable. How then could friendship be described scientifically?**

The authors point out how certain metrics for a smile defining the size of the opening of the oral aperture could be developed, but science, it seems, "can talk about human beings only in a dehumanizing way." Yet, we can talk about two friends meeting and smiling and we know that something other than simply the opening of the two oral apertures is going on. Our scientific paradigm requires that we use an approach which works well only for objects that are dead. We have a science which completely excludes the ability to describe living things, and it requires that we treat human beings as non-living things! Rightly understood, physiologists and other medical practitioners are usually materialists who study corpses scientifically, and their practice with living human beings, when successful, is more like an art than a science.

If scientists can only talk sense to other scientists, we live in a split culture and each half speaks nonsense to the other.

> **[page 2] In this book we propose to examine science itself and, by tracing the origins of this strange dichotomy, to show a way in which the split can be overcome.**

The scientist can only speaks of objects and see the universe as full of objects. This focus on objects leads to what scientists call their "objective view" of reality. But how can a view be real if it eliminates all of the goodness of life and living — if it takes the two smiles between friends and replaces them with a measurement of the widening of their oral apertures? Scientists have not been bashful about the necessity for such objective measures, at least until recently. Anything not objective would have been called superstitious projections of human beings.

> **[page 6] It is widely considered a major triumph of science to have transcended these superstitions by recognizing them for what they are: projections of our inner life out into the "real" universe. Hence, for real knowledge to be attainable, the "outer world" had to be purged of this inner life.**

Scientists, by eliminating human projections, have eliminated themselves from the world they seek to describe. They have become detached observers of the world, which certainly can be proven to have detached observers in it, but which they exclude in their descriptions. They "see the world as a machine, which they haunt like ghosts." (Page 6) In the mind of scientists, human beings have become the ghost in the machine, passively recording what they observe and calling it science. But knowledge is never created by machines, but by the humans who create the machines. Knowledge is never the product of objects, but only of beings. But if the knowledge human beings create is only of objects, and not beings, are we not thinking of a world in which no human beings exist?

> **[page 10] If we systematically think of a world in which human beings don't exist, we should not be surprised to find ourselves creating a world in which they can't exist.**

Such a world was created cinematically in the 2001 movie A. I. which allows us to see a grim world of robots who have eliminated the humans who created them. This is the ultimate end of a world of materialism in which everything can be reduced to matter: humans are superfluous, and only matter matters.

We put blinders on horses to eliminate their views of shadows in their peripheral vision which would otherwise make them skittish. Scientist have had their blinders on for so long, they dismiss claims that what was once observable by humans in their peripheral vision doesn't exist because they ignore the existence of the very blinders they have donned.

> **[page 13, 14] This dismissal is supported by more than a habit of mind; the beings that apparently peopled the medieval and earlier universes are not to be seen in the world around us. Unobservable today, such beings must have been "imagined" and not "real."**

Children are born without such blinders. They can enjoy their very *real* playmates who are invisible to adults. Parents will likely call their children's invisible friends "imaginary playmates." With the advent of modern physics, especially quantum mechanical effects, scientists are faced with realities which cannot be seen without special instruments, but the same parent who would ridicule a child for calling its imaginary playmate real, will call a reality seen only with a special device "real"!

> **[page 14] Specially designed instruments are required. Nevertheless, we still habitually employ words and concepts drawn from sense experiences, even when speaking about the invisible and intangible realms now under investigation. In high-energy physics, where the materialistic paradigm is most obviously out-of-date, this is quite striking. The words we hear, "particles," "particle accelerators," "targets," and so on, seem to imply**

> **that the objects described would be both visible and tangible if they were not so small. Yet on reflection, scientists realize there is no meaningful way the realms they are exploring can be described as either visible or tangible.**

Other than children, scientists tend to ridicule religion for its superstitious and supernatural beliefs, concepts, and doctrines. Once again we find the process psychologists call "projection" at work. We project when we ridicule others who are doing blatantly and openly what we ourselves are doing covertly, out of our own awareness.

> **[page 16] Materialism is more than a habit in our society. Sometimes subtly, other times overtly, it exerts a force much as religious doctrine did in past ages. Many people in Western cultures — particularly educated people — feel nervous and uncomfortable when confessing to any belief in nonmaterial realities, especially so if asked to describe spiritual, religious, or paranormal experiences (for example, an encounter with the soul of a departed relative). They know that if they appear to take such experiences as real — that is, as "objective" realities — they risk being regarded as mentally unbalanced. A kind of private compartment of the mind containing "religious beliefs" is more or less permissible, even respectable. But such beliefs are regarded as private concerns, whereas science is concerned with public and universal realities. Science now functions in society rather as the Church did in the Middle Ages. It is heresy to doubt that science is the guardian of the most essential and well-established truths.**

Ridicule is the modern form of torture by the Grand Inquisitor of Establishment Science. Such ridicule was heaped upon Immanuel Velikovsky in the twentieth century by establishment scientists, prominently by Harlow Shapely who threatened to take Harvard's textbook publication business away from MacMillan if they published Velikovsky's "Worlds in Collision." After several decades, during which many of the unique hypotheses proffered by Velikovsky were confirmed to be accurate, such as radio emissions from Jupiter, the American Academy for the Advancement of Science (AAAS) invited the aging scientist to speak to their annual meeting in San Francisco. The ailing, 87-year-old Velikovsky was made to wait at the podium all day and listen to scientists berate his theories, call him a crackpot, among other less polite phrases, and only *after* all the press had left with their notes, late in the afternoon, was the eminent multi-disciplinary scientist allowed to present his case. No medieval torture chamber could match what the 1980s AAAS had planned for Velikovsky who had *dared* to suggest that global catastrophes could have shaped the world and its inhabitants.

After duly chastising Velikovsky and sending him off into the sunset to die ignominiously, the very same scientists resurrected his idea that global catastrophes had eradicated the dinosaurs from the Earth, one of the minor, but important aspects of Velikovsky's theories. And they did this without ever publicly crediting him. Let no one attack the bastion of establishment science is the very strong message to be taken from this episode. This case shows that they will be treated today as Galileo, Giordano Bruno, and his fellow scientists were treated by the establishment religion of their time. They only castigated Galileo, but they literally burned Bruno at the stake. Let no one doubt that Science guards its established truths as blindly and zealously today as the Church did in Galileo's time.

A curious process is occuring with the advent of quantum mechanics. Establishment science is being radically changed from within because something keeps slipping past their materialistic blinders and saying to them, "Look at me! I can't be explained by your limited view of the world." Edelglass etal will show us how this happens, but first the authors explain how the blinders of science were constructed by scientists who "selected a limited set of perceptions for attention and ignored others."

It began with Galileo the scholar who carefully observed and learned from the craftsmen who worked in his region of Italy. He identified certain "primary qualities" of moving bodies such as size, shape, quantity, and motion. Galileo first worked the strength of materials where he deformed matter until it broke and reported the results. The next area he studied was *kinematics* or the study of objects in motion, such as

rolling a metal ball down an inclined plane or dropping two different weight balls from the Tower of Pisa, his most famous experiment. "Secondary qualities" were all those other aspects of our senses and human experience of objects such as color, smell, taste, sound, etc. These are produced in our mind but are considered irrelevant for describing the external world. Primary qualities were considered measurable and secondary qualities were not, and as such were mostly ignored by materialistic science.

Instead of living human beings inhabiting a living world of which we were an intimate part, after Galileo's time, we morphed into isolated beings in an isolated, out-there world which we could describe kinematically but were otherwise separate from. Science evolved into a field where we soon became able to measure the very large and the very small. With each advancement of measuring tools, we learned more about the hitherto invisible objective world out there. There seemed to be no limit to what we could learn if we peered into the microscopic and macroscopic world. This all came to a screeching halt with the advent of the Heisenberg Uncertainty Principle which told us that there was a limit beyond which we could measure both *position* and *velocity* accurately. He showed that to measure either one *accurately* meant to lose our *precision* for the other. Suddenly the idea that scientists could know all about our world by measuring more accurately collapsed.

We in the nascent twenty-first century are facing a new paradigm which has not been completely fleshed out yet. As typically happens the new paradigm must sprout in the soil of the old which is crowded with the metaphors, the words, and the concepts of the old. We live now in a world of processes instead of objects, and we continue to talk about objects as if they were still the ultimate reality. Worst still, we have very handy scientific techniques to fuel our technological world which are rooted in the old paradigm and still work for us. Our technology allows the pragmatists among us to say, "Who cares?" when confronted with the dilemma the philosopher-scientist David Bohm confronts head-on with his "implicate order."

In Chapter 3 our authors deal with our "Changing Relations to Physical Reality" and take a look at how we, since Galileo, have changed our outer world from "a living, sprouting, warm, and colorful home into a bowling alley for dead, solid, small particles of varying shapes, masses, and sizes."

> **[page 54] This was the only view that could be described by mathematics and therefore experienced with the self-evident certainty of the thinking mind. Hence, Galileo was confident that the reality of this experience was self-evident. As a consequence, new technology was discovered that changed the outer world not only in imagination but also in reality.**

Then we hit the wall which Heisenberg described for us. Our bowling ball devolved into a fuzzy wave which somehow moved from our hands down the alley, but only materialized again when one or more of the tenpins fell down. Our bowling ball model of the electron was dealt a serious blow when atomic experiments showed that it could jump from one alley to another (one atomic orbit to another). Then quantum science showed that we could never be sure if there was a localized bowling ball rolling down one alley or a pervasive wave filling the entire bowling arena!

> **[page 63] The blurring of the absolute distinction between waves and particles, a distinction fundamental to classical science, had — and still has — far-reaching implications for understanding the nature of physical reality. Within quantum science it cannot be said that a wave is a wave or a particle a particle. Under some conditions a particular entity will behave as a wave, under others as a particle. This so-called wave-particle duality presents a paradox insoluble to ordinary thinking about physical reality. With this paradox we pay for having presumed to solve the paradox of action at a distance.**

The key to understanding the problem lies in the concept of pseudo-phenomenal thought. A atom pictured as a nucleus with whirling electrons around it does not exist except in our thoughts. It is a useful fiction for describing the atomic structure, but the description is *not* a reality, it is only a map of some unknown

processes going on out there outside of our mind in the phenomenal and unknown world of the atom. It ceases to be a useful picture of the atom when we confront evidence which contradicts the picture, a paradox, in other words. The existence of a paradox tells us that there is some aspect of reality which our map, model, or whole paradigm of science is not equipped to handle or explain. An atom as we have been taught to picture in our high school textbooks is a pseudo-phenomenal thought. It is a crutch that helps us learn to walk and it must be discarded if we wish to run.

> **[page 70] Until the advent of the atomic model of matter, scientists had developed mathematical ideas in an almost instinctive interplay between observation and thought. This was not true of the next model, which "explained" the differences between solids, liquids, and gases in terms of the motion of atoms carrying energy, otherwise called heat. Atoms were regarded as imperceptibly small versions of ordinary solid particles following the usual laws of mechanics. For classical physicists and chemists, they were the entities that really underlay the phenomenal world and were discovered in the same way fields had been discovered: mathematically in imagination.**

Aren't these mathematical fictions useful for discovering things? Yes. But at some point we must recognize their limitations and discard the very tools which led us to our present location where the tools are no longer useful.

> **[page 70, 71] The mathematical models devoid of pictorial content that are typical of modern science resulted from attempts to fit the concepts of atoms and waves to the discoveries made at the end of the nineteenth century that led to quantum theory. Although atoms and waves lost, in this theory, their physical, commonsensical qualities, they still seemed useful in discovering new mathematics. Our mathematics has guided us into realms of the world in which the concepts of mechanics with which we started are no longer applicable. As long as the pictures of wave and particle are regarded only as analogies, just as the elastic forces were analogies for fields of force, they are useful. The danger lies in our becoming secretly and unconsciously convinced of the reality of these pictures despite paying lip service to their model nature. The models then prevent us from taking the next necessary step to recognition of the quantum and relativistic worlds for what they are: completely new and previously occult realms of experience in which, to begin with, we can find our way only with mathematics as a guide.**

Chapter 4 deals with "Conscious Participation" which is a concept which I was first introduced to by Owen Barfield in 1988 book, Saving the Appearances (1) and the authors reference that same book. The authors discuss the phenomenon of a thunderstorm from a personal experience perspective and then from a scientific perspective, in other words, from a subjective and an objective perspective. In the first the human being is the observer and a participant in the storm and in the second the human doesn't exist, except as a dispassionate observer. Take lightning, for example: Ben Franklin may be the first person we know of who blended the subjective and objective when he performed his kite-flying experiment to show that lightning is an electrical phenomenon.

> **[page 79] It seems strange to modern human beings to find the experience of nature interwoven with the process of gaining scientific understanding. It appears that the objective and the subjective are being confused. Only the discovery of general laws and the exact description of events are generally accepted as scientific. However, when we abstract general law from the circumstances of actual individual experiences, we are ignoring parts of reality that are, nevertheless, valid aspects of any scientific endeavor. The scientist tends to replace the actual experience of events with imaginations of modeled events in order to preserve the fiction of a detached observer. These models are then often applied to experimental situations devised to accommodate the models. When the models seem to be validated by results from such an artificial environment, the**

> **question must be asked: Have we discovered something about nature or about our cleverness in designing environments to match models? In this chapter we are attempting to demonstrate that scientific results can also be achieved by an investigator who remains conscious of those aspects of human experience that inspired inquiry in the first place and of the faculties used to gain scientific understanding.**

Next the authors tackle two aspects of vision: the spatial aspects of light and the color and brightness aspect. As a physicist I was taught to understand the spatial aspects of light by drawing light rays and calculating the reflection in a mirror by measuring the angle of incidence and making the angle of reflection equal to it. But these rays are merely pseudo-phenomenal objects, thought-images created for convenience. No where can one find the phenomenon of a single light ray the size of a point. What the authors do is describe reflection as Edelglass does in his book, The Physics of Human Experience, by using a real object standing in a reflecting surface such as a lake. No light rays are necessary and one arrives at the same result, but without the use of pseudo-phenomenal artifacts. Imagine how different the impact of the two approaches would be on teaching children about the laws of reflection.

The color and brightness aspects they describe are amazing. Nothing that I had learned as a physicist prepared me for this. I was taught that Newton showed that one could send a ray of light through a prism and that the prism would split the ray of white light into a spectrum of colors. But the light ray is pseudo-phenomenal and the prism experiment hides more than it reveals of the phenomenal world. Try the tile experiment in the passage below, and you will notice that you can achieve the same spectrum of colors as with a prism, but without losing contact with the phenomenon of color and brightness. Colors are discerned only with the sense of sight as is our perception of brightness and darkness. Yes, physicists have instruments which can measure brightness and color, but these are mostly useless to people such as artists who work closely with color. Learning this cleared up another puzzlement for me: why it was that I could understand color as a physicist but could not understand it as an artist. To grasp the reality of color and brightness phenomena, the authors lead us to looking into water.

> **[page 88, 89] Now let us change our focus and consider colors seen in the lake. We already noticed that the blue of the water changes with its depth. Although they are not nearly as obvious, we may notice other colors when we look at the bottom of the lake and at the rocks and pebbles. Close observation reveals that the edges of objects at the bottom are sometimes blurred and fringed with narrow bands of color. The fringes become more pronounced as the edges appear more raised. Although the colors may be brilliant, especially in bright sunlight, they are easily overlooked because the fringes are so narrow. Once they are noticed, they appear like narrow openings into a new, magical world of color.**
>
> **Imagine we are looking at a submerged white tile leaning against the side of a large tank of water. We view the tile from the opposite side against a dark background. As we bend down to bring our eyes near the surface, the image of the tile will rise while shrinking in its vertical extension. Its upper edge will blur, turning into a blue fringe from which a violet haze radiates up into the dark above it. The lower edge will turn into a red fringe, over which a yellow haze darkens the adjacent white of the tile above it. The two basic fringes and hazes develop simultaneously as the image rises. A dark object on a white background would develop the same colors, but with the locations reversed.**
>
> **If the tile is short enough in height, the haze from below will eventually impinge on the fringe above it. Their colors will react: yellow and blue producing green, magenta forming through the reaction of violet with red. The six colors produced are always the same: violet, cyan (or light blue), green, yellow, red, and magenta. These six colors can be arranged in a circle (rather than in a band). While the color with which we start this circular arrangement is arbitrary, the sequence of colors is not; it is a product of direct color experience. Intermediate shades can easily be pictured leading from one color to another. For example, between violet and cyan we can picture indigo, ultramarine, and many shades of blue, but not green; between yellow and red there are all the oranges,**

but not violet. Moreover, wherever we start, the end color of the series is a neighbor of the first. Between the magenta and violet in the series cited, there are various shades of pink that are more red or more blue respectively, the nearer they are to the magenta or to the violet. These observations are consistent with arranging the colors in a circle rather than in a series.

Instead of the pseudo-phenomenal rays of Newton describing a band as physicists are wont to think of, we arrive at the color circle that artists require in their daily work. But most importantly this experiment did not involve light rays passing through a prism, but light reflected from a white tile leaning against the side of a tank. We can now understand better how the spectrum of Newton was produced because we are led to understand how colors are produced by colored areas interacting with one and another.

I could not understand what my wife was saying when she told me things like this, “Your shirt does not go with your pants.” or “Your tie does not pick out the colors of your shirt.” The physicist-me was unable to comprehend how a color could change by being placed near another color. Then one day, I had a thought that perhaps colors are like tones in music. Striking two tones that make up a chord creates a dramatic effect while striking two tones which are not part of a chord produces a dissonant or no effect. Maybe color schemes are like chords in music! This was my start at thinking about colors in a phenomenal instead of pseudo-phenomenal way. My physics way of thinking about colors flew out one window and in from another window came my artist way of thinking about colors.

I began to experiment with colors. Around this time, I had taken to wearing athletic shirts under my everyday shirts. I bought them in several shades of color: red, green, blue, yellow, orange, and some intermediate colors as well. Living in sub-tropical New Orleans, I wore my shirts un-buttoned so that the undershirts were visible. By paying attention to the colors I saw in the mirror when I wore the same patterned overshirt with various colors undershirts, I began to see that the color of my undershirt actually *changed* the color of my overshirt! There was *nothing* in my physics training that prepared me for that discovery! And yet what was a discovery for me as a male of forty something at the time was something that my wife seemed to know from her early childhood. Clearly she was amazed that I hadn't known that also from my childhood.

Here's the results of a little experiment. I stopped typing and took three photos of the shirt I have been wearing as I wrote this review. I took one photo with an orange undershirt, one with a blue undershirt and one with a red undershirt. You can see the results for yourself. The overshirt actually looks different in the two photos and the only thing that changed with the small triangle of the undershirt which is showing. To get the full effect you should cover two of the photos and look at just one at a time. Generalize this result to ties, hats, pants, shoes, socks, and other pieces of clothing, and you men out there for

whom this is new information will have some new wardrobe challenges, er, make that opportunities, facing you when you dress for work or play from now on. Remember: this is old information to the women in your life already, so they can probably help you sort out this information. It is also known to those who studied science phenomenally as our four authors did.

> **[page 92] It is clear that there is no definite answer to the question, What is the color of this surface really? In fact, the question makes no sense. *Color is not something that exists independently of its surroundings.* The chemical nature of the surface, that is, the pigments it contains, is a very important determining factor. The physical properties of the surface, such as rough or smooth texture, also influence its appearance. Another factor is the illumination. What is usually forgotten is the human sense organ itself. Our sense of color seems to depend on the totality of the scene perceived. As we have observed, the color of a "beige" cushion varies with illumination as well as with the surroundings.**

The authors show us that we get wave-like results from light experiments if we use mirrors and particle-like results if we use photographic emulsions. It is not the nature of emission that is important, but rather our method of recording.

> **[page 104] In other words, when it is designed to record wavelike phenomena, our apparatus shows interference patterns. And when it is designed to discover particle-like phenomena, our apparatus records individual spots. Apparently, in situations such as these we see what we set out to see. But, then, we may ask, What is light itself? This question is paradoxical because it is formulated within a context that presupposes light to be a thing that moves through space. Such a thing cannot be reasonably imagined as being both continuous and discrete. Since the phenomena themselves, interference patterns and spots on photographic emulsions, cannot be faulted, it appears that it is the way we think about the phenomena that is faulty.**

And the way we've thought about light was pseudo-phenomenally, up until now. We treated light as waves and it worked. We treated light as particles as it worked. So which one is it? Neither. It is what it is, and what it is will not be found by the use of metaphors such as waves and particles from the non-light world to describe light. Our use of pseudo-phenomenal concepts in the classical mechanical world worked well, but they have failed us in the quantum mechanical world.

> **[page 105] The failure of thinking suggested by quantum mechanical paradoxes lies in the misplaced attempt to understand phenomena in terms of pseudo-phenomenal things imagined to actually bring about effects. Instead, the method of conscious participation described in this chapter seeks to find conceptual relationships between conditions and phenomena. An abstract pseudo-phenomenal realm is not inserted as a barrier between human thinking and human experience of the actual phenomenal world.**
>
> **Nineteenth-century science tried to unite the whole body of natural science under a single aspect: mechanics. Twentieth-century physics has shown that this plan is, in principle, infeasible. Even inside the limited field of optics we must follow up at least two different approaches that lead us into two distinct realms; each one is valid. The**

> **twentieth century is teaching us more than that: nature and humanity are becoming more and more involved in crises that are the result of our applying a "scientific" self-assurance appropriate only to one field: classical mechanics. We must learn to give up building all science on the basis of its success in the single realm of mechanics.**

If we give up trying to understand color using the pseudo-phenomenal approach that worked for us in classical mechanics, we may come to understand such concepts as the tree in our backyard has no color! What is the color of a tree if each person sees it from a different angle, with a different colored background and a different illumination? The question cannot be answered except by the extreme reductionist approach using pseudo-phenomenal concepts, concepts we have found seriously wanting in the twenty-first century in which we live.

> **[page 116] Color is thought to arise in human consciousness as a response to electromagnetic radiation that is pictured as energy waves moving through space. These waves, which we endow with the reality of physical objects, are thought to produce colored images of varying brightness in human observers and are therefore given the name "light." Since, however, in this view color is not present until the human being responds to this stimulus, the tree itself *cannot properly be said to be a particular color.***

Certainly the objectivists among us will object to this last statement, that the tree itself has no color. So the authors take us back to an objectivist view of the tree.

> **[page 116, 117] Let us return to the objectivist view of the tree. According to this conception, the tree absorbs and reflects light in its own characteristic way. Such absorption and emission processes do not require color for their description, neither does the description of light radiation itself. Accordingly, color concepts must be introduced in order to describe the *experience of seeing* and not to describe what is, in the objectivist view, presumed to actually be there independent of seeing. The conclusion is inescapable that an unobserved tree is devoid of color. But how do we mentally picture an unobserved tree? Could a colorless tree be anything other than invisible?**

We are left with the startling view that, "within the objectivist conception, nature as we experience it cannot exist as a reality in an external world that is independent of human observers." (Page 118) Physical science has come to this end by focusing solely on primary qualities or things that are measurable.

> **[page 118] In a way we have come full circle. Not only is a smile made grotesque by science and robbed of its human meaning (chapter one), but also *nature itself* is made meaningless when we limit reality to what is measurable and, therefore, spatial in character and experienced only through the body senses.**

Why does a baseball seem to stay the same size as it approaches you in the batter's box? This is taken by some objectivist minded scientists as a potent example of the limitations and errors of a subjectivist view of the world. The authors describe a simple experiment that anyone with a finger and two eyes can easily perform to understand why we see a baseball keeps the same size as it approaches us.

> **[page 122] When, for example, an approaching baseball does not appear to the batter to grow larger, it is taken as evidence of the subjectivity of the human sense organization. We have the naïve confidence that the size and location of an object, such as a baseball, can be measured and that such a measurement is independent of our own selves. It may be that such a measurement can be carried out for the baseball, although it is no simple matter when it is moving! To understand the situation correctly, we must appreciate the difference between observing a directly oncoming object with one eye or with two. Moving a finger toward your nose and observing it with only one eye, you will see it increase in size as you would expect from the laws of perspective. Viewed with both eyes, however, the size of the finger does not change. In the first case, the finger is seen two**

> **dimensionally in perspective, as if it were a changing painting. In the second case, however, the finger is seen three dimensionally through the muscular cooperation of both eyes, each eye seeing a slightly different view. The latter case is the situation with the baseball. Attention is on the object itself rather than on the scene. The situation is similar to the problem experienced when the location of the refracted image of an object does not coincide with the location of its tangible perception (or, where we feel it to be). We simply bring thinking to bear, along with whatever sense perceptions are available, so as to order the situation in thought. Reality is this ordered understanding. In this way scientific knowledge is subject to constant elaboration and revision. Thus, reality becomes increasingly well known.**

If we truly wish to experience reality, we cannot get by focusing only upon our *senses* any more than we can get by focusing only upon our *thoughts*. True science must involve both senses and thought! Thus the title of the book is made manifest for us: Physical reality must marry together both sense and thought. This requirement was first brought forth, to my knowledge, by Rudolf Steiner, an Austrian-born philosopher, in his 1894 book The Philosophy of Freedom. Over a hundred years later, physics and the other sciences have evolved to the point where we are being forced to consider the necessity for a marriage of sense and thought.

> **[page 123] We showed that science can be carried out without resort to bodily-spatial assumptions concerning the nature of reality. Instead, our only assumption was that physical reality consists of sense phenomena ordered by concepts appropriate to the phenomena. This bringing together of concepts and sense-perceptible manifestations is physical reality. It is the business of science to bring them together. In this we agree with Rudolf Steiner, who suggested that the split we experience between what comes to us through thinking and what comes to us through our senses is a consequence of the human organism [Steiner 1988]. The split is not an imperfection of the human being, but instead the basis for our freedom. A baby must first distinguish between itself and its surroundings before being able to use the word *I*. Our sense of being an independent individual can arise only through separation from the world. This separation is given through our unique constitution. The split between inner and outer experience forces us to work with pictures in our consciousness. Those pictures, being *only* pictures, do not have the coercive power of external reality. Hence we are free to distinguish and combine them as we wish without, initially at least, doing any harm. The scientific work of thinking with pictures educates us and helps us evolve new faculties. Cognition in the true sense is more than gaining information; it is an active participation in the world through which we develop new capacities.**

To listen to many talk, we live in a fragile world, an Earth that is undergoing such horrors as global warming due to the pseudo-phenomenal greenhouse effect caused by carbon-dioxide emissions, holes in the ozone layer due to usage of fluorocarbon-based products, lost of oxygen in the atmosphere due to cutting down of rain-forests, pollution of our streams, lakes, rivers, and oceans by industrial and farm wastes, increasing illnesses of all kinds, and that lists only a few areas of problems seen by the reductionists. And each reductionist has a special interest group who lobbies for more funding to combat their favorite problem as they deem necessary to save the Earth.

The authors of this book in the section called "Morality and Choice in Science" put it quite well:

> **[page 135] Human beings are creating a world that is increasingly inhospitable to themselves or anything else alive. The empathetic basis on which we relate to nature is eroded, as is that on which we relate to each other and to our own selves. Our impotence to reverse these trends derives from our unquestioning acceptance of the hypothetical-reductive-mathematical methods of science. We seem to feel that such methods are logically necessary. Reductionists are convinced that objective knowledge can be gained**

> **by no other means. However, built into these methods is the unsupported presupposition of a reality that, in its finality, is static, fragmented, and impersonal. Within such a reality there is no place for life or sentient beings.**

How can reductionists see the Earth other than fragmented and fragile if their very methods presuppose a reality itself that is "static, fragmented, and impersonal." Anyone who lives in a house that is static, fragmented, and impersonal could well be afraid of its collapsing at any time. Abandoned houses could be described as static because no one repairs them to forestall their collapsing; they are fragmented as certain rooms could be shut off from use and become a fire hazard or roof leak hazard for the rest of the houses; they are impersonal because only vagrants would live in them and therefore they could *care less* about the condition of the places when they leave them.

It is my personal opinion that the Earth is neither fragmented or fragile, but that the Earth is whole and robust! It can even survive the reductionists who would unintentionally destroy it with their presuppositions and over-zealous and incautious corrective actions.

> **[page 135] Even people aware of these difficulties and possessing a healthy sense for life find themselves unable to act in ways that are integrated with their humanity. Professional ecologists, for example, personally relate to nature out of an innate sense for its wholeness. It is usually this awareness that initially drew them to pursue their scientific studies. But "wholeness of life" does not have the status of reality either within the scientific community or in public life. Thus, ecologists cast their investigations in purely economic terms, hoping that monetary values can influence public policy and save nature from destruction. But this approach is wrong on two counts. For ecologists themselves it is self-destructive because of the fundamental personal untruth. Furthermore, it supports the idea that economic gain should be the primary motivating factor in our relationship to the natural world and to one another.**

The very scientists to which we look to make things better are hobbled by their own reductionist roots.

> **[page 135, 136] We could list innumerable similar examples of people working in ways that increase fragmentation while they themselves inwardly sense that something is fundamentally wrong. Instead, we would like to suggest the reason few people take the risks required to change this situation: deep down they feel that it is scientifically impossible to justify any ultimate reality other than one of impersonal building blocks. Despite its inner longings the modern psyche embraces the contemporary materialistic worldview of science on some level. Perhaps we feel that the price of its abandonment would be the loss of our self-identity. Sadly, it is now clear that the selfhood we would preserve is gradually being permeated by a sense of meaninglessness that is the real price of our continuing to think in the framework of the modern worldview.**

Steeped in a culture which teaches only of impersonal objects in the world, they are unable to perceive their own wholeness and project their lack upon the world and thus see the Earth as fragmented and in danger of collapse.

> **[page 137] The form and the spirit of the questions asked specify the nature and contexts of permissible answers. The goal of recovering the reality of nature within scientific description can be achieved only in the context of wholeness. This means that we must search for and investigate the most important aspects of phenomena directly perceptible to us rather than lose ourselves in the pseudophenomena characteristic of the usual reductionistic methods.**

Those who claim that science is value-neutral suffer the biggest delusion of all. Their very choice of reductionist science as the solution leads them and others away from the very phenomena which can unify humanity and bring wholeness to nature.

> **[page 137] We must recognize that choice is possible. Do we wish to involve ourselves with the world of phenomena, with nature as a whole, or do we wish to fathom the microscopic world with its atomic, fragmented character? The two worlds are concurrent and distinct. Either path can be pursued. The path we choose has far-reaching consequences for humanity. It is literally true that we create and are responsible for the reality in which we live. Uniting ourselves with phenomena will tend to unify humanity and bring wholeness to nature. If we choose reductionism, not only nature but society too will be reduced, fragmented. We can no longer use the fiction that science is value-neutral in order to escape our responsibility. The practice of science, the nature of our questions, carries with it, from its very inception, a moral choice and a moral responsibility. The morality of science is not simply a matter of how results are used! Furthermore, since nature and humanity are inseparable, their evolution is also inseparable.**

Holism and reductionism must be united. We must see the split between sense and thought not as an human imperfection, but rather as the very basis for our freedom as Steiner explained to us over a hundred years ago. Rightly understood, sensing and thinking are our paths to seeing and nurturing our lives and nature on this robust Earth.

---------- ***Footnote*** ----------

Footnote 1. The small size of my review of Barfield's book is more due to the length of my early book reviews than to the serious impact the book had on my life. It was a a book that caused me to view the entire world differently and made me to want to reread every other book I'd ever read, so pervasive was the effect Barfield's words, ideas, and thoughts had upon me. But for Barfield, I would likely have never read Rudolf Steiner's works or found my way to the concepts in this present book.

Return to text directly before Footnote 1.

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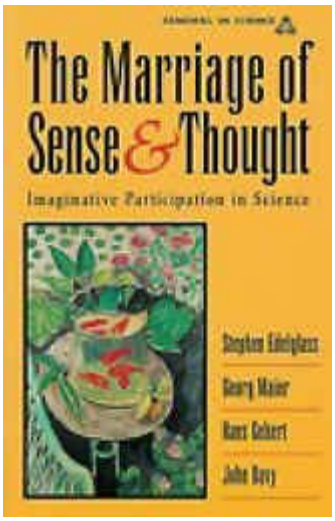
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