A READER'S TREASURY

The Structure of Scientific Revolutions
Second Edition, Enlarged
Chapter: Evolution of Consciousness

by
Thomas S. Kuhn
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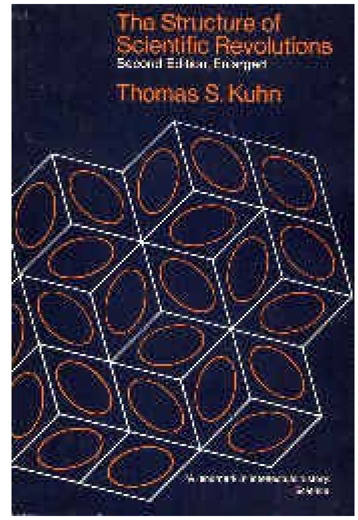
A Book Review by Bobby Matherne ©2007



The first edition of this book was published in 1962, within a month or so of my graduation from college in physics. It took me about 15 years to locate this book and about 15 minutes to realize how important it was to me as a scientist. Kuhn explained to me things that had puzzled me from the time that I outgrew my textbooks in physics and the other sciences. How was it that the major innovators in the sciences, men like Galileo, Newton, Dalton, and Einstein, were able to create their new ideas about the physical world? The textbooks made their discoveries sound so simple and logical that their discoveries seemed to be easily deducible from the state of science as they found it in their time. And yet their discoveries were amazing. How does one reconcile these two contradictory ideas? Kuhn laid it out for me like a "patient etherized on a table" readily available for inspection.

By the time I began to read Kuhn, I had studied the Gestalt psychologists who pointed out how we can look at the drawing of stacked cubes such as the ones on the book cover above and see a particular cube as coming out from the page or going into the page. I had read Benjamin Whorf's hypothesis and speculations about the effects of language on one's world view. Also I had encountered the story of Bruner and Postman's experimental results with the "red six of spades and black four of hearts" stuck into a deck of otherwise normal cards. Kuhn built upon these and other ideas to create the idea of a "paradigm" which represents an exemplar of a key experiment in science like Galileo's dropping of a heavy and light weight from the Tower of Pisa to demonstrate that they both fell at the same rate of speed or Michelson-Morley experiment that established the non-existence of a material ether through which light travels. This was one of meanings Kuhn used for paradigm.

The other was a more general meaning and referred to the complete set of maps and metaphors of reality that comprise a science. If you operated within those maps and accepted the metaphors of a particular field, you could call yourself a scientist of that field; if not, you were ignored by the other scientists of that field. Kuhn co-opted the obscure word *paradigm*, which formerly meant only a model, such as *amo, amos, amat* is a model for conjugating the verb *to love* in Latin, and applied it to the field of science. He took it out of language classes into the general vernacular. One hears the word used commonly today in sentences such as, "My company has adopted a new paradigm."

What Kuhn did for science is to highlight the power of its paradigmatic approach to reality, and the flaws of the approach. A paradigm can be like a dam holding back the flood waters of heresy or it can be a stone wall which deflects the arrows of anomalies from penetrating its *sanctum sanctorum*. A paradigm can lubricate the everyday processes of science and it can prevent any paradigmatic anomalies or deviancies from ever leading to a newer and more robust science. A paradigm can be a boon or a boner, a safe haven for productive work or a neurotic shelter from the real world.

Kuhn says that his "most fundamental objective is to urge a change in the perception and evaluation of familiar data." If we are viewing and evaluating our data through paradigmatic-colored glasses, then he urges that we become aware of that, and learn to take them off from time to time when anomalies arise so that we see and evaluate the data directly. It is only thus that new paradigms may ever arise.

These two quotes will highlight the two contradictory aspects of a paradigm.

> **[page viii, from the Preface] Yet, somehow, the practice of astronomy, physics, chemistry, or biology normally fails to evoke the controversies over fundamentals that today often seem endemic among, say, psychologists or sociologists. Attempting to discover the source of that difference led me to recognize the role in scientific research of what I have since called "paradigms." These I take to be universally recognized scientific achievements that for a time provide model problems and solutions to a community of practitioners.**

> **[page ix, from the Preface] In addition, the view of science to be developed here suggest the potential fruitfulness of a number of new sorts of research, both historical and sociological. For example, the manner in which anomalies, or violations of expectation, attract the increasing attention of a scientific community needs detailed study, as does the emergence of the crises that may be induced by repeated failure to make an anomaly conform.**

When I mentioned above that "I outgrew my textbooks," I used an expression that I learned from Kuhn in this book. Our image of science comes from our textbooks, and many scientists never outgrow this image. Unless we, as scientists, come to realize the actual historical development of sciences that lay behind the images drawn for us in the tourist brochures we call textbooks, we cannot understand the limitations under which we have been operating out of our awareness, up until now. Up until Thomas Kuhn.

> **[page 1] That image has previously been drawn, even by scientists themselves, mainly from the study of finished scientific achievements as these are recorded in the classics and, more recently, in the textbooks from which each new scientific generations learns to practice its trade. Inevitably, however, the aim of such books is persuasive and pedagogic; a concept of science drawn from them is no more likely to fit the enterprise that produced them than an image of a national culture drawn from a tourist brochure or a language text.**

We must come to think about Galileo's views, not in relation to modern science, but in relation to the state of science in his own time. This, Kuhn tells us, is what historians of science are beginning to do, and what led him to his interest in paradigms as a way of understanding the evolution of consciousness that accompanies a scientific breakthrough. In Galileo's time, there were many ways of understanding the motion of falling bodies and pendulums, many schools of thought on the subject. Each school had its individual paradigm. And yet Galileo found a way to solve problems that resisted the ablest members of the other schools of thought or paradigms. He performed outlandish experiments and led his "profession at last to a new set of commitments, a new basis for the practice of science." (page 6) He created a new paradigm for experimental science that we take for granted today.

About twenty years ago c1987, I met Joseph Westley Newman, an inventor, in Lucedale, Mississippi. He had a machine that he claimed produced greater external energy output than external energy input. Over the succeeding years, this type of machine came to be known as an "Over-Unity Energy Machine" and hundreds of experimenters came up with their own version of an over-unity machine. Newman had a theory that his machine converted mass into energy by Einstein's equation of energy conversion [$E=mc^2$]. This type of conversion of mass to energy falls outside the current paradigm of science, and except for the theory as expressed in his book, *The Energy Machine of Joseph Newman*, Newman's findings have *no* basis in the current paradigm of science, up until now. The situation in the Over-Energy field today mirrors that of the field of optics during Newton's time. These men were all scientists and their findings had no basis in theory at the time.

> **[page 13] Yet anyone examining a survey of physical optics before Newton may well conclude that, though the field's practitioners were all scientists, the net result of their activity was something less than science. Being able to take no common body or belief for granted, each writer on physical optics felt forced to build his field from its foundations. In doing so, his choice of supporting observation and experiment was relatively free, for there was no standard set of methods or of phenomena that every optical writer felt forced to employ and explain. That pattern is not unfamiliar in a number of creative fields today, nor is it incompatible with significant discovery and invention.**

Without a guiding paradigm, all the data for a new field seem equally important and lacking a paradigm with its adherents, an innovator in a new field will direct one's comments in writing to anyone who might be interested in the subject matter. This was the case with Benjamin Franklin's book describing his experiments with electricity. Once a paradigm is established, this is no longer the case. The books and essays are no longer addressed to the general public as Kuhn points out.

> **[page 20] Instead they will usually appear as brief articles addressed only to professional colleagues, the men whose knowledge of a shared paradigm can be assumed and who prove to be the only ones able to read the papers addressed to them.**

What happens upon the onset of a new paradigm? We find scientists who are no longer engaged in inventing new theories, but rather in substantiating their new theory, what Kuhn colorfully labels a "mopping-up" process. It was my realization as a graduate physicist that if I continued in my field, I would be involved in this process. At the time I thought of my future career as "spending a lifetime extending the decimal point on a physical constant." That realization led me away from physics as a primary endeavor.

> **[page 24] Few people who are not actually practitioners of a mature science realize how much mop-up work of this sort a paradigm leaves to be done or quite how fascinating such work can prove in the execution. And these points need to be understood. Mopping-up operations are what engage most scientists throughout their careers. They constitute what I am here calling normal science. Closely examined, whether historically or in the contemporary laboratory, that enterprise seems an attempt to force nature into the preformed and relatively inflexible box that the paradigm supplies. Not part of the aim of normal science is to call forth new sorts of phenomena; indeed those that will not fit the box are often not seen at all. Nor do scientists normally aim to invent new theories, and they are often intolerant fo those invented by others. Indeed, normal-scientific research is directed to the articulation of those phenomena and theories that the paradigm already supplies.**

Kuhn tells us on page 34 that most of the normal work of science is of three sorts:

> **1.) Determination of significant fact**
> **2.) Matching facts with theory**
> **3.) Articulation of theory.**

In order to be a scientist one's work must fall under one of those three categories of work. These three types of work comprise the paradigm of scientific work. Kuhn sums it up by saying that "to desert the paradigm is to cease practicing the science it defines." Practicing science is like assembling a jigsaw puzzle. One may use any technique one wishes, but at the end of the job, the finished puzzle must closely resemble the paradigmatic picture on the cover of the box.

But new scientific facts are hard to come by. Any discovery of a new phenomena that exists outside a scientific paradigm is treated as an anomaly and basically ignored, often for a very long time. In the scientific practice of medicine in 19th Century Vienna, it was a common practice for doctors to go from the dissecting room to the delivery rooms without washing or disinfecting their hands. In fact, disinfecting had not been invented yet. When Ignatz Semmelweis discovered he could save thousands of lives of women in childbirth, who would else die from puerperal fever, by requiring hand washing in an antiseptic solution, his practice was ignored by the doctors, and the administrator of the hospital eventually had Semmelweis confined to a mental hospital. The history of the acceptance or lack thereof of antisepsis in the medical profession clearly shows the dangers to someone who dares "to desert the paradigm" of his field of endeavor. Or someone like Joseph Newman, who dares to reveal evidence at variance with the expectations of the current paradigm of electrical engineering. The choices are basically two: to be treated as a crackpot and ignored or treated as insane and hospitalized.

If Joseph Newman's motor is producing more electricity than it consumes, then other motors may have done the same in previous times, but lacked a theory or a paradigm that allowed them to notice that it was happening. So the phenomenon was ignored.

A similar thing happened in the field of X-rays. Cathode ray tubes (CRT) are used to create X-rays. Adjusting the plate voltage in any CRT to a high level is enough to cause X-rays. This is avoided today, but in the early days of CRT's, X-rays were unknown. Unknown, that is, until Roentgen stumbled upon his paradigmatic demonstration by discovering that he had exposed a photograph plate in a desk drawer, through the top of the desk, outlining the image of a key in the drawer. Before him, no one noticed that CRT's could emit X-rays because no paradigm existed to call attention to the phenomenon of X-rays.

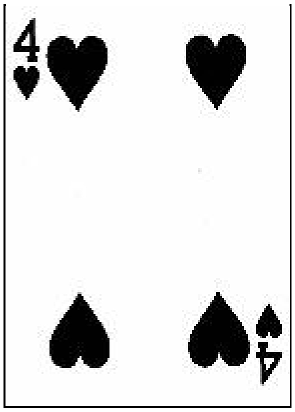
> **[page 59] By the 1890s cathode ray equipment was widely deployed in numerous European laboratories. If Roentgen's apparatus had produced X-rays, then a number of other experimentalists must for some time have been producing those rays without knowing it.**

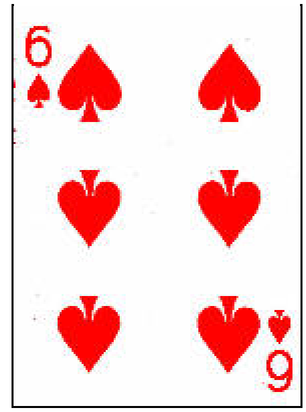
Uranium fission is another interesting tale. Kuhn tells us that the two fission products were Krypton, a noble gas, and Barium, which was added to test for elements at the upper end of the periodic chart. Scientist were looking for much heavier elements and ignored the presence of the fission products of Krypton and Barium that had actually been produced for a long time while they were searching for heavier fission products. The researchers were wearing paradigmatic blinders. (page 60)

I mentioned earlier the Bruner and Postman experiments with card decks. Here's Kuhn explaining the experimental set-up. Notice the implications for science in this experiment which isolates the process of paradigmatic blinders for us.

> **[page 62, 63] In a psychological experiment that deserves to be far better known outside the trade, Bruner and Postman asked experimental subjects to identify on short and controlled exposure a series of playing cards. Many of the cards were normal, but some were made anomalous, e.g., a red six of spades and a black four of hearts. Each experimental run was constituted by the display of a single card to a single subject in a series of gradually increased exposures. After each exposure the subject was asked what he had seen and the run was terminated by two successive correct identifications.**

The results showed that subjects ignored the anomalous cards, calling them either the six of hearts or the four of spades upon short exposure. The really interesting responses came as the exposure increased. When I showed my wife the two anomalous cards, and asked what they were, Del said, “The one on





the left is a four of . . . hearts." She had to stop to inspect the card and said later that she thought the card was upside down because the black hearts looked like an upside spade to her at first. Here's one typical and enlightening response from an experimental subject of Bruner and Postman:

> **[page 63, 64] One of them exclaimed, "I can't make the suit out, whatever it is. It didn't even look like a card that time. I don't know what color it is now or whether it's a spade or a heart. I'm not even sure now what a spade looks like. My God!" In the next section we shall occasionally see scientists behaving this way too.**

I have seen scientists behaving this way at Joseph Newman press conferences over the years when he displayed and demonstrated his energy machine in various configurations. In face of a demonstration that violated their basic paradigmatic beliefs, they were at a loss for words to describe what they had seen.

Scientists are taught that when science, their map of the world, does not match with the world, it is the map that is changed. One of my bosses who grew up in Norway told me once that in his Norwegian Boy Scout Handbook in the section on map reading was the following caveat:

> **"When the terrain differs from the map, *believe the terrain*."**

In a terrain where a single misstep can send one plummeting into an icy fjord, this is an excellent motto to follow. While it would seem to be the motto of scientists of all kinds, the exact opposite is true in practice. When direct observations or experimental evidence directly conflicts with their paradigm, they tend to believe their paradigm and discount the evidence of their senses and instruments. Can you see how these tendencies make difficult the emergence of any new paradigm of science? What do scientists do when "confronted by even severe and prolonged anomalies" to their paradigm? Do they readily accept these anomalies as falsifying their theory. No.

> **[page 77] These hint what our later examination of paradigm rejection will disclose more fully: once it has achieved the status of paradigm, a scientific theory is declared invalid only if an alternate candidate is available to take its place. No process yet disclosed by the historical study of scientific development at all resembles the methodological stereotype of falsification by direct comparison with nature.**

What they do instead, Kuhn says, is "devise numerous articulations and *ad hoc* modifications of their theory in order to eliminate any apparent conflict." What they cannot do is reject their paradigm and continue to call themselves scientists. (page 78) They are in the position of the captains of a ship at sea when confronted with their ship's foundering and sinking into the sea. The moment they abandon their ship, they are no longer its captain. That's why it is often said that "captains goes down with their ship." The role of captain does whether the person assuming the role chooses to or not.

One other point I've noticed is that adopting a paradigm is like buying a new brand of car: soon you see cars like it everywhere. Or wearing a tie that *brings out* one of the colors in one's shirt. This is such a well-kept secret among women that it took me about fifty years to understand what they were talking about when they said "brings out". Colors have a harmonious relationship to each other just as notes in a musical chord do. In color matching, unlike the cube diagram gestalt example, it is *not* possible to alternate back and forth by an act of the will - the new emphasis of colors take on a reality that the mind alone cannot overcome.

What Kuhn stresses again and again is the point that "there is no such thing as research in the absence of any paradigm." (page 79) Paradigms function for science like a bootstrap loader does for a computer. You cannot load a program into a computer without a program already in the computer to load it. Somehow, someone at the factory must come up with a bootstrap loader of first resort and thereafter *every* program that is loaded depends on that bootstrap loader.

> **[page 86] Often a new paradigm emerges, at least in embryo, before a crisis has developed far or been explicitly recognized.**

One innovator that I met over the years was Doyle Philip Henderson, an aerospace instrument engineer and designer for most of his adult life. He designed the first digital lapsed time counters that were used at Bonneville Salt Flats. He invented some aircraft chocks for preventing an airplane from rolling. He was a part of the secret team that designed the SNARK, the very first intercontinental guided missile. And he came up with a cosmological discovery about every human being that rightly belongs in the field of psychology. How did he manage this feat? He wasn't wearing the paradigmatic blinders of those in the field in which he made his discovery. This is *not* an unusual situation, Kuhn tells us, to have an innovative solution or discovery come from someone who is new to a field.

> **[page 90] Almost always the men who achieve these fundamental inventions of a new paradigm have been either very young or very new to the field whose paradigm they change.**

The science of doyletics named after Henderson did not deal with phenomena previously unknown, but rather formed a "higher level theory than those known before and linked together a whole group of lower level theories without substantially changing any." (page 95) With the paradigm for the etiology of emotions and feelings and other bodily states provided by doyletics, one can explain how the many and vary psychotherapeutic practices work to achieve relief from distressing bodily states. These include psychoanalysis, age regression, rebirthing, gestalt therapy, NLP, and many more. Each field has, like the field of optics had before Newton, its own explanations, its own procedures, and its own mystique. And various levels of success with its clients. What doyletics does is bring a science into the field that will, in time, unify the various fields and enable practitioners in all the diverse fields to become more effective in their work.

Doyletics meets one of the prime requirements Kuhn gives for a new theory:

> **[page 97] But if new theories are called forth to resolve anomalies in the relation on an existing theory to nature, then the successful new theory must somewhere permit predictions that are different from those derived from its predecessor.**

The predictions that one can make once one understands doyletics are discussed in the website, but I'll relate a couple that surprised me. Allergies can be removed by a simple memory technique as suggested by doyletics. Severe vertigo can be alleviated or removed entirely by the technique, as can migraine headaches, acrophobia, sea sickness, stage fright, frustration, anger, depression and many more things. Each of these things I have personal knowledge of their removal. There are many more that I have anecdotal knowledge of from the reports of others. The world of physical body states that even to the trained psychotherapist can seem to be, in William James's phrase, "a bloomin' buzzin' confusion," to someone trained in doyletics, becomes an easy subject for a doyle trace to remove unwanted physical body states (doyles).

Paradigms are resistent to change, as Kuhn pointed out; once a paradigm is in place it has an inertia of its own, requiring an outside force to move it or change it. Kuhn can be considered to have applied Newton's

1st Law of Motion to the Philosophy of Science. A paradigm at rest will remain at rest until acted upon by some force from outside the paradigm. Since anyone inside the paradigm will have on paradigmatic blinders, they cannot see the possibility of change. Change therefore must come from outside a paradigm, just as a force to set a body at rest into motion must come from outside the body as Newton rightly saw. One might even stretch the other two Newtonian laws of motion to apply to paradigms: 2) The rate of change of paradigmatic shift is porportional to the outside force applied and 3) Every action of paradigmatic shift creates an equal and opposite reaction within the paradigm. (The reaction of the Phlogiston advocates to Lavoisier's discovery of oxygen as the agent of combustion is well-known.)

The change from an old to a new paradigm, whether it is an historical one like Newton's, Dalton's, or Einstein's, or if it's a current one such as Newman's Energy Machine or Doyletics, requires that competing groups undergo a gestalt switch. It is an all or nothing process and it takes time, usually lots of time, for that transition to occur. Again textbooks do beginning scientists a disservice by masking that time of transition to new paradigms, up until now. Sometimes, a new generation must grow up for whom the new paradigm is no longer new before it is accepted generally by the public. It was with that idea in mind that I quoted Max Planck in the section I wrote in *The Energy Machine of Joseph Newman*. And it was in Kuhn's book that I'm here reviewing that I first found that amazing quote.

> **[page 151] And Max Planck, surveying his own career in his *Scientific Autobiography*, sadly remarked that "a new scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die, and a new generation grows up that is familiar with it."**