THE PERENNIAL CHALLENGE OF ANOMALIES AT THE FRONTIERS OF SCIENCE

Beverly Rubik

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Institute for Frontier Sciences, 7711-D Mc Callum St, Philadelphia, PA 19118, USA. *[Current location: Center for Frontier Medicine in Biofield Science, Institute for Frontier Science, Oakland, CA, in consortium with University of Arizona, Tucson]*

Note: Edited with comments in [*brackets and/or italicized]* added, 2008, by Phillip W. Warren; phillip_warren@telus.net

["You can recognize pioneers by the arrows in their backs!" -- Raymond Damadian, inventor of the MRI (Magnetic Resonance Imaging) machine on his experiences with canonical/mainstream scientists' judgments of his ideas.]

1. Introduction

Scholars have documented the resistance to novel scientific discovery by various groups, such as economic and religious groups. However, there has been less attention given to the resistance of the scientific community itself to challenging scientific discoveries (Barber, 1961). Nonetheless, we find it in the history, philosophy, and sociology of science and especially in the writings of those scientists who have personally suffered obstacles due to this resistance. Whereas the scientific community believes that it deals with novel controversial discoveries in a rational manner, this is rarely the case.

The history of science, medicine, and technology is full of rejections of novel discoveries that seemed anomalous in their time. Contemporary scientists laughed when *Benjamin Franklin* proposed that lightening was a form of electricity. *Semmelweiss*, a Viennese physician who documented that washing one's hands before obstetrical assistance would prevent child bed fever, was scorned and rejected by his contemporaries. *William Crookes*, the noted British scientist and member of the Royal Society who discovered the element thallium, was bitterly attacked by his scientific colleagues for his research in parapsychology. *Lord Kelvin* said that X-rays were a hoax. *Helmholtz*, who was not a physicist, but a medical doctor who formulated the theory of energy conservation and who was opposed by the physicists of his time noted how the "greatest benefactors of mankind usually do not obtain a full reward during their lifetime" (Murray, 1825). *Lister* warned medical students against blindness to new ideas in science, such as he had encountered against his own theory of antisepsis. Long after their time, many of these scientists whose ideas were rejected were regarded as formative thinkers who made significant contributions or even launched new scientific paradigms.

2. The Scientific Paradigm

In 1962 Thomas Kuhn published a seminal work, *The Structure of Scientific Revolutions*, which addresses the manner in which science advances. Kuhn's main thesis is that science is not a slowly growing body of knowledge approaching a true description of the world. Instead, science is characterized by periods of quiet research activity leading to a crisis, which may last for years to decades. During this transition period, scientific problems appear that cannot be resolved within the given paradigm. Scientific anomalies, experimental results that cannot be reconciled with current theory, may occur. Such anomalies are critical to progress in science.

In fact, each new major advance in science starts with an anomaly that is unacceptable at first[*]. Therefore, anomalies are valuable because they inspire new ways of thinking. Conventional scientists attempt to explain the anomalies within the framework of the dominant paradigm, while a smaller, usually younger group of scientists develop an alternative paradigm. The crisis is resolved by a dramatic change of perspective, a paradigm shift *[with new research methods to test the new perspective]*. A struggle typically ensues that may result in the overthrow of the old paradigm. After the triumph of the new paradigm, the old paradigm eventually disappears in a time frame necessary to provide stability and confidence in the new paradigm. What was an anomaly earlier now becomes the expected result. Textbooks are rewritten such that they even disguise the very existence of the revolution that generated them. Eventually, new research uncovers problems with the new paradigm. Then the process repeats itself.

Kuhn notes how unconsciously ingrained the dominant paradigm is. He wrote, "*Scientists often work from textbook models acquired through education and through subsequent exposure to the literature without knowing or needing to know they are accepting a community paradigm*" (Kuhn, 1970). They work to fit their data into the ruling paradigm. The usual *peer review* process in science provides an adequate forum for evaluating new ideas and discoveries, but this is only true if those ideas and discoveries do not challenge the paradigm. As was mentioned previously, those considered incomprehensible or too challenging to current scientific understanding are typically rejected. *Michael Polanyi*, in defending this conservative nature of science, wrote, "There must be at all times a predominantly accepted scientific view of the nature of things, in the light of which, research is jointly conducted by members of the scientific community." Any evidence which contradicts this view has to be disregarded, even if it cannot be accounted for, in the hope that it will eventually turn out to be false and irrelevant" (Truzzi, 1990). Although the neglect of other possible conceptual categories is not malicious in intent, it can become malicious in effect because the dominant paradigm discourages and poorly tolerates competitors. That is, scientists prefer their work to appear as an integral, growing body of knowledge under the auspices of a single paradigm. Perhaps this is because scientists are encouraged to demonstrate what they know rather than to raise truly novel questions that challenge what they think they know. *[Much of science applied is thus based on fear of being different.]*

Kuhn recognized an "essential tension" within science because it must preserve its accumulated knowledge by acting cautiously and conservatively, and on the other hand, remain an open system ready to take in novel, potentially revolutionary data and concepts (Kuhn, 1977). This balance is maintained in a number of ways. *First*, science places the burden of proof on those who claim to discover scientific anomalies or otherwise make revolutionary scientific claims. *Second*, the proof must be commensurate with the claim; that is, extraordinary claims require stronger than usual proof. (This relates to the principle of parsimony in science in which the simplest adequate theory is the most acceptable.)

It is interesting to note that Kuhn (1970) believes that science generally progresses in a positive direction, but that some paradigm shifts have reversed concepts such that aspects of an even older paradigm may return in the form of new input reshaping old models. It is a common conviction that the world is progressing in one direction scientifically and socially, but as Kuhn points out, very often the clock is turned back with new scientific developments. For example, relativity and quantum theory, two of the most significant scientific paradigm shifts in the twentieth century, both turned back the clock in certain ways. The gravitational aspects of Einstein's general relativity reflect back to Newton's predecessors, and quantum mechanics has reversed some of the methodological prohibitions that had occurred in the earlier chemical revolution. Needless to say, the reshaping of older views into a new paradigm would have significance for homeopathy and low dose bioeffects. Many scientists today have the attitude that these phenomena from an era predating modern molecular biology have been overthrown, or that at best they represent a placebo effect. These scientists are victims of *historicism* who refuse to accept anything from an earlier time as bearing any modicum of truth.

3. Scientific Anomalies

According to science sociologist *Marcello Truzzi*, an anomaly is something that: (1) actually occurs (that is, something both perceived and validated); (2) is not explained by some accepted scientific theory; (3) is perceived to be something which is in need of explanation; (4) contradicts what we might expect from applying our accepted scientific models. I would suggest that the anomaly's lack of fit with accepted theory is the necessary element common to any real anomaly. It is a fact in search of an explanation (Truzzi, 1987).

In the field of anomalistic observations, or anomalistics (Wescott, 1980), that is, inquiry into anomalies and their role in science, there are different types of scientific anomalies, at least in retrospect. There are those that are recognized in their time by the scientific mainstream that become the subject of legitimate research activity, and those that go ignored by them because they are apparently too threatening. Many of the latter come from the "frontier sciences," that is, whole areas of scientific inquiry that have not yet been incorporated into conventional science. These areas are ignored or even considered irrelevant by the mainstream, in some cases, because they are often residues of older systems of knowledge that have been denounced as pseudo-science, as, for example, parapsychology and astrology.

The history of science shows that the most challenging anomalies, those that seriously challenge the dominant paradigm, are ignored by the scientific mainstream until they are explained, and only then are they recognized in retrospect. The term retro-recognition has been given to this type of recognition only after there is a compelling explanation for the anomaly (Lightman and Gingerich, 1991). Such anomalies make the scientific community uncomfortable, as it likes to think of science as an integral body of knowledge that is nearly complete. These unexplained facts are either ignored, reduced in importance, or merely accepted as "givens". *Several factors are behind this attitude*, such as the sheer intellectual difficulty in recognizing anomalies, the tendency to ignore a problem that cannot be easily solved, and the conservatism of science. But there is something more. The recognition of what were once anomalies under an older paradigm only after they are reconciled with a new paradigm clearly shows that *the scientific community is unable to live with ambiguity and cognitive dissonance* (psychological inconsistency). However, frontier scientists whose work challenges the paradigm appear to be of a different psychological makeup, with a higher tolerance for ambiguity and cognitive dissonance. It is interesting to note that such tolerance correlates highly with creativity scores in psychological testing (Barron, 1963). Furthermore, frontier scientists may be working from dimensions other than rationality and logic, for Kuhn has written, "The man who embraces a (new) paradigm at an early stage must often do it in defiance of the evidence. A decision of that kind can only be made on faith." (Kuhn, 1970)

4. The Role of Skepticism

Indeed, it is rare to find those scientists who are true skeptics, that is, without prejudice, open, and tolerant of uncertainty. It is unfortunate that *the term "skeptic" is being used by many who are disbelievers or debunkers whose aim is to remove the anomaly*, rather than true nonbelievers (Truzzi, 1987). This appears to be particularly the case for organized so-called skeptics groups such as the *Committee for the Scientific Investigation of Claims of the Paranormal* (CSICOP), which sponsors unusual critiques and other activities to discredit anomalous scientific claims, undermining the usual processes of replication attempts and peer review. In some cases this has involved members outside of the scientific community such as professional magicians in a process analogous to inquisitors for a dogmatic church (Maddox *et al*., 1988). Unfortunately, this has the effect of creating fear among those who would have an interest in trying to replicate the anomaly, thereby blocking real scientific inquiry. *[This is what Robert Anton Wilson (RAW) had to say about fundamentalist materialism in an interview by David A. Banton (DAB) Complete interview available at* *http://www.nii.net/~obie/1988_interview.htm*

"RAW: I coined the term irrational rationalism *because those people claim to be rationalists, but they're governed by such a heavy body of taboos. They're so fearful, and so hostile, and so narrow, and frightened, and uptight and dogmatic. I thought it was a fascinating paradox: irrational rationalists. Later on I found out I didn't invent that. Somebody else who wrote an article on CSICOP, that's the*

group they all belong to: Committee for Scientific Investigation of Claims of the Paranormal. *Somebody else who wrote about them also used the term irrational rationalism. It's a hard term to resist when you think about those people." "I wrote this book* (The New Inquisition: Irrational Rationalism and the Citadel of Science) *because I got tired satirizing fundamentalist Christianity, I had done enough of that in my other books. I decided to satirize fundamentalist materialism for a change, because the two are equally comical. All fundamentalism is comical, unless you believe in it, in which case you'd become a fanatic yourself, and want everybody else to share your fundamentalism. But if you're not a fundamentalist yourself, fundamentalists are the funniest people on the planet. The materialist fundamentalists are funnier than the Christian fundamentalists, because they think they're rational!"*

"DAB: They call themselves skeptical."

"RAW: Yes, but they're not skeptical! They're never skeptical about anything except the things they have a prejudice against. None of them ever says anything skeptical about the AMA, or about anything in establishment science or any entrenched dogma. They're only skeptical about new ideas that frighten them. They're actually dogmatically committed to what they were taught when they were in college, which was about 1948-53, somewhere in that period. If you go back and study what was being taught in college in those days as the latest scientific theories, you find out that's what these people still believe. They haven't had a new idea in 30 years, that's all that happened to them. They just rigidified, they crystallized around 1960."

CSICOP = Committee for the Scientific Investigation of Claims Of the Paranormal *which see themselves as the defenders of the faith. Robert Anton Wilson says the acronym should stand for Committee for Slander, Invective, and Calumny against Open-minded People. Indeed, they function as the religion of Scientism's version of the Catholic Church's "Congregation of the Doctrine of the Faith" whose function is to silence dissenters.]*

Where there are anomalies and frontier areas of science that seriously challenge the paradigm, the scientific community is often polarized into two categories: believers and disbelievers. Although the scientific community may consist largely of disbelievers, sometimes the frontier scientists or proponents of an anomaly act as "true believers". In some cases there are societies of "true believers" centered around maverick scientific claims that do not welcome open dialog. In my opinion, they are no better than some of the mainstream scientists they criticize. Sometimes the discoverer of a challenging fact overstates his claims, jumping to conclusions about the importance of his discovery without adequate data. On the other hand, the "essential tension" of the scientific process renders it very difficult to find the right balance in reporting anomalous claims. If the discoverer understates his claim, it may go ignored; if he stresses its revolutionary character, it may gather more attention and resources for further study. From my own work aiming to facilitate new research and greater open-mindedness in frontier areas of science, I find that it is a difficult position to stand firm on the fine line that separates the believers from the disbelievers. In my opinion this is the best viewpoint to encourage an attitude of nonbelief that stimulates new questions and further experimentation. Apparently this viewpoint is not well understood or liked by most, as I am often accused of being "the enemy" of one group or the other. However, openness and a healthy level of skepticism are crucial in order to avoid pathological science. *[After leaving CSICOP, Marcello Truzzi started another journal,* *the* Zetetic Scholar. *He popularized the term Zeteticism as an alternative to Skepticism, because the term Skepticism, he thought, was being usurped by "pseudoskeptics." A zetetic is a "skeptical seeker". The term's origins lie in the word for the followers of the skeptic Pyrrgi in ancient Greece.]*

5. The Power of New Questions and Approaches in Science

Scientists must approach nature by asking questions of her, and it is impossible to pose a question without some expectation or anticipation. Clearly, from the analysis of Kuhn and numerous other scientific historians and sociologists, *science is not context-independent*. Scientific objectivity does not reside in theory-free perception. It lies in the flexibility to reject a cherished theory when an anticipated observation cannot be confirmed, and a contrary event or fact is perceived instead. Scientists may say that they see the data with their own eyes, but in fact, they see it through their brains. They cannot bypass this central focus and filter full of biases, products of both evolution and society. It is very difficult to "see" scientifically beyond the context of theory or expectations.

As an example, consider the following. Before Darwinism, the paradigm that preceded evolutionary theory was natural theology, in which each creature was considered to be perfectly adapted to its environment and designed for full functionality. While natural theology dominated, no one noticed that some organisms were less well adapted to their environment. Natural theology would not permit such questions. Ducks with webbed feet that could not swim, birds with wings that could not fly, and bats with eyes that could not see, went unnoticed. Darwin asked new questions and noticed that some animals were less well-adapted for their environment. He explained these anomalies on the basis of natural selection, an ongoing evolutionary process. The point here is to show the power of asking new questions that take us outside of the present scientific theory or paradigm. These offer the possibility of a breakthrough to a new way of seeing nature. As physicist Werner Heisenberg noted, "What we observe is not nature itself, but nature exposed to our method of questioning."

Another historical example of this goes back to microscopy of the 17th and 18th centuries. The great microscopist *Van Leeuwenhoek* and his contemporaries claimed they saw minute forms of complete babies inside sperm under the microscope. Their observations were shaped by the 2000-year-old idea that women contributed nothing to conception but the womb as an incubator. In this case, too, preconceived ideas determined what was scientifically observed.

In another historical example involving microscopy, different methodological approaches of observation based on different philosophies led to a scientific debate. In the 1940's the bacteriologist *Adrianus Pijper* maintained that bacterial flagella are not true motor organs, but are essentially insignificant, being merely cell wall byproducts of bacterial motility (Strick, 1994). From his observations of live bacteria under the dark-field microscope, he claimed that he saw small changes in the forms of the bodies of the bacteria, a slight undulating motion, which he proposed as a theory of bacterial motility. As it turned out, his view was unpopular because he was far outnumbered by those who fixed and stained dead bacteria for light microscopy or electron microscopy, which was newly introduced at that time. The majority of scientists then claimed that flagella were indeed the organelles of motility and showed evidence via microphotography of sites of flagellar attachment to the cell body. Pijper rejected these physical approaches, emphasizing that studies on the living state itself were critical to understanding cellular motility, and that the approaches using dead cells might yield artifacts. This lead to an ongoing debate, as both schools refused to "see" any evidence beyond their own viewpoints. In the end, Pijper lost the debate. His refusal to acknowledge the "superiority" of the electron microscope was held against him by the scientific majority.

Beyond the specifics of this historical debate, the latter case is important for us to consider because it reveals the perennial struggle between the naturalist and the mechanist in biology. It shows how naturalists' observations of living systems were replaced by a modern biology tightly linked to physico-chemical reductionism as new powerful, expensive, prestigious, technological tools came into being. These new physical methods require an often insensitive manipulation of organisms that distorts or even kills them in order to study them. The naturalists' approach came to be regarded as old-fashioned and even reminiscent of vitalism to the new biologists, who were led by several physicists-turned-biologists in the 1940's and 1950's. These were the people who ushered in a new scientific era, the revolution that became the dominant paradigm of molecular biology and biotechnology in recent decades.

6. The Resistance of Scientists to New Discoveries

The historical examples cited earlier illustrate only a few reasons why resistance to novel discoveries in the scientific community occurs. Analysis of many other examples shows numerous ways in which scientists resist discoveries that are old paradigm breaking and new paradigm making. One of these mentioned earlier is the loathing of ambiguity. *Most scientists prefer to elaborate what they think they know than rather focus on what they do not know*; perhaps this is simply human nature. Along with that is fear of novelty. New discoveries require restructuring older ideas and ways of doing science. Change, whether it is personal, social, or intellectual is difficult, and may even cause a lifetime of work to become unimportant and obsolete.

Studies on the psychology of science suggest that scientists have a resistance to acknowledging data that contradicts their own hypothesis (Truzzi, 1990). In one study on falsifiability, a simple experiment was set up to compare the performance of a group of scientists and a group of clergymen. A false hypothesis was given to all of the participants. The means was provided for them to test the hypothesis, which they did not know was false. The results showed that most of the scientists refused to declare the hypothesis false, clinging to it longer despite the lack of evidence. The clergymen, however, more frequently recognized that the hypothesis was false. This and other studies show that scientists are at least as dogmatic, authoritarian, and irrational as non-scientists in resisting unexpected findings. *[The main problem with science as scientisim, i.e. an organized ideology much like religion, is that they convert theory and hypothesis into canon and dogma. Thus, rather being a source of expanding knowledge, theory as dogma becomes a block.* ***True Believers*** *are the enemy of inquiry. Remember, the initials for* B*elief* S*ystem are* BS*!! When I, Phillip W. Warren, was teaching introductory psych students, I was constantly hearing something like "I don't believe that. It's not true." In frustration I devised the aphorism (or what ever)* "The belief that 'What I believe is true,' is false!" *Some of them got it.]*

Related to this is the fact that older scientists have a tendency to resist the novel work of the younger. Innovative "outsiders" may also be rejected by the "insiders," especially if the new discovery comes from outside the field, as in the case of cold fusion**. There is also a faithfulness to old models, reflecting a belief in scientific concepts or simply conservatism. *[Remember the medieval scholars, when arguing about how many teeth a horse had, consulted the writings of ancient scholars rather than examine a real horse. A good example of this pathology in the field of sensory psychophysiology is detailed in the book by Chandler Burr (2002)* The Emperor of Scent*, Random House, "Author's note" section where the* ***True Believers*** *in the molecular shape explanation of odor detection (the "shapist" camp) refused to consider the brilliant Luca Turin's alternative, vibrational or frequency coding. In 1995, Martin Rosendaal commented "He's the first person to apply quantum mechanics to a physiological problems." The shameful behaviour of the "shapist" camp succeeded in suppressing, for now, any alternative approaches.]* When *Thomas Young* proposed a wave theory of light, the scientific community remained faithful to the older corpuscular theory for some time. This tendency sometimes reveals a dogmatism or scientism. *Paul Feyerabend* accuses contemporary science of being a "church" in which scientists play a role that is in many respects similar to the role bishops and cardinals played not too long ago (Feyerabend, 1980). Another mode of resistance, also illustrated by the example cited earlier of Van Leeuwenhoek and his colleagues, is blindness due to preconceptions. It is extraordinarily difficult to "see" what may lie beyond one's paradigm, which delimits all questions posed of nature and ways of perceiving her.

Anomalies without "causes" or an adequate explanatory model are rejected because they do not fit neatly into the body of science. If an anomalous claim pertains to an area reminiscent of mysticism, religion, older paradigms that have been overthrown, or pseudo-science, this may be grounds for rejection by those who feel threatened by these associations. Along with that, occasionally conflicting personal religious ideas may be a reason for rejection. That was the case for both Galileo and Copernicus, and it also appears to be a factor in the debate between Creationists and Evolutionists.

Scientists evaluating an anomalous finding sometimes take into account the relative professional standing of the discoverer as well as the number of prestigious followers of the new claim, and these are primarily political concerns. *Concerned about their reputation, scientists are reluctant to take the lead in helping to advance a new claim*. In relation to that, publications about the new scientific claim in other than the most prestigious peer-reviewed journals are taken less seriously and may be grounds for rejection or simply neglect. Finally, and perhaps most important to contemporary science is that where substantial funding is involved, patronage to those ideas endorsed and funded to the exclusion of others is overwhelming.

Today, because of large economic interests in science, biomedicine, and technology, and the increasing overlap between academia and industry, the resistance to new discoveries or ideas that challenge the dominant paradigm goes well beyond ideological concerns. *Challenging ideas can be seen as threatening to big business interests*, including the interests of those industries waging war against cancer or AIDS. Anyone who is a proponent of ideas that threaten large-scale economic interests can expect even harsher backlash from the scientific community, which in mainstream biology and medicine, is now closely linked to pharmaceutical and biotechnology firms. Surely that is one of the most significant reasons for rejection of novelty in biology and medicine today. Moreover, the many different fields of biology with their varied orientations to life that existed before big business science are presently extinct, at least in the U.S. It is simply taboo to challenge seriously the dominant paradigm, and those who propose such maverick ideas or findings suffer extraordinary obstacles. Similar to the acceptance of novel discoveries, the obstacles are especially severe for those whose work threatens big economic interests that are now coupled to mainstream science.

7. Obstacles Faced by Scientists who Challenge the Paradigm

There are a number of serious, even extraordinary obstacles that scientists presently face as proponents of paradigm-challenging discoveries or where their reputation becomes associated with research on unconventional topics. These obstacles are not characteristic of a particular culture; they appear worldwide.

(1) There is difficulty in *obtaining funding*, as there are simply no usual sources.
(2) There is difficulty in *publishing*, and there is no real peer review.
(3) There is *loss of camaraderie*. Colleagues fear a loss of reputation by association with a scientist who is deemed an outcast.
(4) There is *loss of reputation* in the scientific community regardless of one's stature.
(5) There are obstacles to *promotion, retention, and tenure*.
(6) There is possible *critical backlash* from the scientific community.
(7) There is a possible *loss of employment* and future employment opportunities.

The pursuit of research in frontier science areas such as homeopathy and extremely high dilution bioeffects, novel medical therapies or diagnostics, new energy technologies, and consciousness studies -- research in any area that challenges the dominant paradigm -- poses extraordinary hardships for scientists. Merely expressing an interest in these can affect one's reputation as a serious member of the scientific community. Whether one is a postdoctoral researcher, a junior professor, a member of a distinguished national academy of science, or a Nobel laureate, essentially the same obstacles remain. For those who have seemingly overcome these hurdles, publications of challenging scientific results may bring about unforeseen backlash in the form of discrediting the discoverer or the claim without really disproving it, prohibiting it from being tested by others. Moreover, this may prevent consideration of similar challenging claims in the scientific literature, textbooks, and education. The proponent of the anomalous claim is thus isolated from further debate and interaction with rest of the scientific community.

Many people associate such repressiveness with earlier times, but there are living examples today. One illustrious example -- a case where big economic interests in biotechnology and medical testing are threatened -- is that of *Peter Duesberg*, professor of molecular biology at the University of California at Berkeley. His work identifying the first oncogene to cause cancer and also decoding the first retrovirus genes earned him an outstanding international reputation as a molecular biologist and virologist. However, because of his recent criticism of the oncogene theory of cancer and especially his criticism of HIV as the cause of AIDS, he has essentially been silenced by the scientific community. No one will debate his arguments either in writing or in person. Duesberg is unable to publish in prestigious peer-reviewed journals, not even the *Proceedings of the U.S. National Academy of Science*, despite his stature as a member of the National Academy, because they rewrote the rules especially to prevent him from publishing. He lost his annual $300,000 Special Investigator Grant from the U.S. National Institutes of Health, which was expressly for the purpose of asking novel questions, and as a result, his students and technicians have had to leave. Duesberg *has been excommunicated* from the scientific community. Needless to say, the review panel who refused to renew his grant included scientists who earn their living from the theories that Duesberg is undermining, and many others in the mainstream also earn their living from these theories.

8. Strategies Toward Progress in the Frontier Sciences

With all of the obstacles and resistances, how can we help facilitate rational, objective criticism and fair peer review of anomalous claims? What strategies can we implement to bring progress to a frontier science area such as homeopathy and low dose bioeffects?

(1) We must recognize that there is no single critical experiment that can prove an anomaly. This is ridiculous from the scientific viewpoint, as the history and philosophy of science has shown that there is no such thing as a critical experiment.

(2) More empirical studies need to be undertaken by more researchers, and we need to work together at least to provide peer review of each others' work, if not outright collaboration. All too often, the work of pioneering frontier scientists represents isolated, individual efforts. By contrast, most quality science involves collaborative efforts. It is important to build on one another's work. Just as cooperative or collective phenomena in nature have unusual stability, there is also a strength in collective scientific efforts that is harder to dismiss.

(3) An interdisciplinary approach to anomalies is absolutely necessary, because we do not know ultimately where an anomaly will fit. In the case of homeopathy or high dilution bioeffects, interdisciplinary group collaboration with experiments performed in tandem on the same high dilution would be worthwhile, because for the first time it would reveal physical, chemical, and biological information about a single preparation. This could develop into an international task force, a global cooperation, to address the problem.

(4) We must produce well-designed experiments that are well-communicated in the scientific literature, which will presumably continue to demonstrate the effect in a wide variety of biological systems.

(5) We must show replication of phenomena, especially by skeptics.

(6) We must also discover and document where no such anomalous effects are observed, so that the boundary conditions of the effect are clear.

(7) Conceptual work toward achieving a theoretical explanation for the effect is crucial for its

recognition.

(8) We must keep the communication flowing between those working in the field who don't agree on the details. A diversity of opinions is extremely important because it drives the formation of new questions. Good science requires good and effective criticism. Furthermore, failures in communication from splinter groups in frontier areas of science only weaken the case, as their presence makes a statement to the scientific community that there is weakness or irrational behavior associated with the anomaly.

(9) One of our best strategies would be serve as mentors and inspire younger scientists to conduct research in novel areas of science. For one, it is most likely that presently established scientists will have to retire before a paradigm shift is completed, and most of them will not change their viewpoint. As physicist Max Planck sadly noted," *A new scientific theory 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*" (Kuhn, 1970). Niels Bohr put it somewhat differently: "*Science advances -- funeral by funeral*."

(10) Retired scientists, who have less to lose in terms of their reputation or funding, are occasionally more open to new ideas or discoveries. Moreover, they may still wield political power in the scientific community. Therefore, communications with or other involvement of retired colleagues may be a viable strategy.

(11) Another strategy that may be used to advance scientific recognition of a challenging anomaly is to identify and align with whatever social, political, or economic interests that would very much like this particular piece of scientific unorthodoxy to be true, or at least to be highly interested in resolving the issue. When *Robert O. Becker*, medical researcher in bioelectromagnetics had the unorthodox idea in the 1970's that electromagnetic fields from power lines might be a health risk, he found no sympathetic ears in the scientific community or the electric power industry. However, he communicated the issue clearly in his popular writings and launched a public campaign in which the people demanded unbiased research to test his ideas. Within less than two decades, substantial U.S. government funds became available for this purpose.

(12) Another approach related to this strategy is to develop a successful application of the anomaly that will bypass the scientific community altogether. Once the application is adopted, scientists will be naturally drawn to the fundamental discovery underlying it.

(13) Finally, we should attempt to foster true skepticism -- neither denial nor disbelief, but a balanced state of openness. The best way to do this is by personal example, by maintaining a level of healthy skepticism ourselves, with an emphasis on further questions. This is crucial to keeping science an open system of inquiry.

9. The Role of Homeopathy and Low Dose Bio-effects in the Future of Science

The observations of low dose biological effects challenge the dominant paradigm of mechanical reductionism, of viewing life as a collection of biomolecules responding to molecular stimuli. The enhanced potency of very low doses as in homeopathy appears to challenge molecular theory, one of the pillars of modern chemistry. On the other hand, it may demonstrate that something else is occurring at these very low doses that does not involve molecules.

Biological effects of low doses have been demonstrated in a growing number of studies worldwide, and we are now in the midst of a paradigm struggle. As Kuhn predicts, an intellectual and emotional battle is occurring: there have been nasty editorials, tenure battles, debates and arguments, splinter groups, the rejection of papers, frequent denial on the part of the scientific community, and many questions that have been raised for further research. From an historical perspective, the accretion of anomalies or numbers of anomalous observations in themselves are not enough to product a paradigm shift. Further effort is required. Conceptual work towards new theories and a paradigm that would reconcile them is critical to their recognition by the scientific community. No one other than the proponents of the anomalies will accomplish this. It remains for us, the frontier scientists, to design the theories, elaborate the new paradigm, and show how they explain our anomalies.

One of the best examples of a conceptual revolution is found in a 19th century science fiction classic: E.A. Abbott's *Flatland*. The inhabitants of Flatland live on a two-dimensional surface and have no concept of our third dimension. When a sphere visits Flatland, he is perceived as an anomaly: a circle that first grows bigger and then smaller. The sphere then lifts the leader of Flatland into the third dimension where he can see his whole world. This novel perspective not only clears up the anomaly, but offers a new perspective for everything. We need a similar major conceptual breakthrough for homeopathy and low dose bioeffects. When it occurs, it may reframe our ideas of matter, energy, life, and information in a radically new perspective. *[see Rubik, (1995) "Energy medicine and the unifying concept of information,"* Alternative Therapies in Health and Medicine*; v.1 #1: pp34-39]*

Presently the greatest challenge to those working on homeopathy or low dose bioeffects is to develop a proper theoretical context for their observations. We need a theory of very high dilutions in the context of the organism. This would enable us to form testable questions that move the research from an accumulation of anomalous observations to a sequence of facts that fit together like pieces of a puzzle. It is becoming more apparent that molecular theory offers nothing but conceptual limitations for this field of inquiry, and that an alternative that goes beyond it must be sought. Moreover, I anticipate that a breakthrough toward a radically new view of chemistry is in the making, and it is long overdue. Quantum chemist, *H. Primas*, wrote (Primas, 1982), "The richness of chemical phenomena renders it impossible to discuss them exhaustively from a single point of view. The molecular view is just one of these views and has no privileged status.... While the molecular theory fell on fertile ground, the further development of a theory of chemical substances was deprived of intellectual incentive. Even today, chemical thermodynamics and chemical kinetics are still in a rudimentary state of development achieved at the turn of the century.... The molecular idea flourished and degenerated into a dogma, requiring unqualified faith."

He also wrote, "Our vision of the world will be severely limited if we restrict ourselves to the molecular view. Molecular theories describe some aspects of matter, but it is not wise to think that they give us a description of reality 'as it is.' If questions of a different kind can be asked, nature will then respond in a new language." *[This is the "nothing but" versus the "something more" battle. It's a hangover from Aristotle's "Law of the excluded middle stated in his* Metaphysics, Book IV, Section 4*. There are alternatives. In Buddhism there is the logical tetralemma which has the form: X is true, X is not true, X is both true and not true, X is neither true nor not true. Then there is a simple "Maybe" Here's a Taoist story to demonstrate this point of* ***THE POWER OF MAYBE***

"There is a story of an old farmer who had worked his crops for many years. One day his horse ran away. Upon hearing the news, his neighbors came to visit. "This is terrible!" they said sympathetically.

"Maybe" the farmer replied.

The next morning the horse returned, bringing with it three other wild horses. "This is wonderful!" the neighbors exclaimed.

"Maybe," replied the old man.

The following day, his son tried to ride one of the untamed horses, was thrown, and broke his leg. The neighbors came again and said "This is terrible!" to offer their sympathy on his misfortune.

"Maybe," answered the farmer.

The day after, military officials came to the village to draft young men into the army. Seeing that the son's leg was broken, they passed him by. The neighbors congratulated the farmer on how well things had turned out. "This is wonderful!" the neighbors exclaimed.

"Maybe," said the farmer."..............]

As to the future of science, research on homeopathy and other low dose bioeffects offers the gift of new questions to the greater scientific community -- not only for homeopathy and solution chemistry, but for the entire theory of condensed matter with ramifications for biology, chemistry, and physics. Chipping away at the molecular dogma and raising uncertainty about what scientists thought was bedrock truth should be seen as healthy for science. As physicist *Louis de Broglie* warned us, "The advances of science have always been frustrated by the tyrannical influences of certain preconceived notions that were turned into unassailable dogmas, and for that reason scientists must periodically reexamine their basic principles." Research on homeopathy and low dose bioeffects may lead to a revision or a refinement of molecular theory, or it may show that something other than molecular theory is involved at these low doses.

There is theoretical work in physics towards a new theory of matter that may hold promise for application to homeopathy and low dose bioeffects. Del Giudice (1991) and Preparata (1992) propose a novel theory of condensed matter based on quantum electrodynamics in which collective or cooperative phenomena are critical to its structure and properties. They show that conventional molecular theory works well for gases, but falls short in explaining the phenomena of liquids and solids. A system of molecules kept together by purely static forces becomes dynamically unstable beyond a certain density threshold. Therefore the system enters a lower energy configuration where molecules oscillate in tune with a self-produced coherent electromagnetic field. The energy gain is proportional to the particle density, and then matter is forced to condense. The theory predicts the appearance of coherence domains in solids and liquids such as water. Because the living cell and its structural subcomponents have dimensions of the same order of size of the calculated coherence domains in liquid water, it is expected that electrodynamical coherence may be relevant to the living state, in terms of enhanced stability and novel energy and information transactions. Such novel energy and information transactions, if they exist, may be relevant for homeopathy.

The results of many low dose experiments suggest new features of matter such as information that may be conveyed by more subtle properties of matter than molecules. It comes as no surprise that living systems, which are well known to involve many levels of order and different types of informational exchange, appear to be sensitive to what may be "informational" properties of very high dilutions of bioactive substances. Experiments from another frontier area of biology suggest that there may be subtle non-chemical bio-informational transfer in cellular systems (Kaznacheev, 1976; Kirkin, 1981). Still other experiments suggest that the zero point energy of the quantum vacuum may be involved in subtle informational transfer in biology (Reid, 1989). Perhaps an appropriate explanation for low dose bioeffects awaits us in a biophysics that is yet to be invented.

Whereas conventional science maintains that biological information is stored and transferred via biomolecular structures such as DNA, there is some indication that more subtle informational signals may elicit biological effects. In bioelectromagnetics there are many observations that extremely low-level nonionizing electromagnetic fields whose energy content is below the physical thermal noise limit can produce biological effects, sometimes robust. There is no agreed upon molecular mechanism for these effects. It has been postulated by some that these may act on the organism in such a way that they affect the organisms's endogenous electromagnetic field, which may be bio-regulatory. That is, they act at the level of the whole organism to provide bio-information or disrupt it rather than at the level of energy or power intensity directed to molecular receptors.

Furthermore, it is possible that several other phenomena that elicit biological effects such as very high dilutions, homeopathy, healer treatments, acupuncture, and other types of "energy medicine" may mediate their effects by means of coherent excitations, forms of electromagnetic bio-information that might interact primarily with the organism's endogenous fields. Endogenous electromagnetic fields, which are properties of the entire organism rather than specific biomolecules, may be involved in self-regulation of the whole organism, and sensitive to a variety of subtle informational signals from the environment. These speculations not only challenge the concept of molecular mechanisms, but also the dogma that mechanical reductionism is the fundamental principle underlying the living state. However, much work needs to be done to develop these speculations into testable hypotheses and theories.

There are a number of other attacks on the mechanistic view of life that those working on homeopathy or low dose bioeffects should be aware of. *Richard Strohman*, a leading molecular biologist and Professor Emeritus at the University of California has recently presented some serious challenges to the genetic paradigm. He argues that the information for cellular activity is not in the individual genes, but is holistically located (Strohman, 1993). In his view, biological research is presently missing this integral program. The creativity of the organism, which is perhaps life's most salient feature, involves the interplay of the integral design and function of the organism with its environment. He raises the argument for an epigenetic rather than a genetic view of life, whereby environmental interactions produce hereditable changes. This means that a nonlinear interaction between the organism and its environment takes place, where the temporal sequence of events determines the complexity that unfolds even in the simplest organism. Of course, it is much easier to ask questions within the mechanistic reductionist framework by studying the fragments of a dead organism. It is much more difficult to study the interaction of genetic and environmental factors in a living organism and develop a science of life at this level. However, most biologists fail to see the limitations of their paradigm and the importance of aiming for this larger context.

There is a popular anecdote based on a Sufi story of a drunk who lost his keys somewhere on a dark street and is groping for them only under the street lamp. When asked where he lost them, he replies that he doesn't know, but he is looking there because the light is good. Similarly, the dominant paradigm of mechanical reductionism has prevailed because the biology community has asked only those questions where the "light is good," and the results are clear cut and reproducible.

Biologists explore, for the most part, those dynamical possibilities for life only where organisms "obey" the paradigm. They have missed the enormous creative potential of life in its subtle interactions and interrelationships. Furthermore, the genetic approach has not permitted "other" questions to be addressed, which, in fact, challenge the conventional approach and the dominant paradigm. Moreover, there is a terrible confusion in contemporary biology between the ontology of life, its epistemology, and the methodology. That is, the methodology used (mechanical reductionism) has frequently been equated with life itself or the model of how it functions. This is particularly true in the U.S. where higher education in science does not typically include coursework in the history or philosophy of science.

The whole organism may be a biological fundamental that cannot be reduced to its parts; the whole may be self-governing by virtue of its long-range electromagnetic fields that are the summation of many electrically charged component species and their interactions. This is reminiscent of the words of *Claude Bernard*, "The vital force directs phenomena that it does not produce; the physical agents produce phenomena that they do not direct." In 1839, when Bernard wrote this statement, the "vital force" was taken to mean a metaphysical concept beyond the scope of science. However, the "vital force" may indeed be a property of the whole organism, a time-varying electromagnetic field summation of all the electrically charged molecular events occurring within it. Subtle biological effects may be mediated through this subtle informational network at the level of the whole.

10. Conclusions

The dominant paradigm of mechanical reductionism that shaped science for the past few centuries, but was overthrown by developments in modern physics earlier this century, still governs modern biology and medicine *[and psychology!!]*. Mechanical reductionism, which was developed for the inanimate physical world, determines the scope of questions that can be posed for living organisms, and conventional biology is the collection of theory and results based on those questions. However, frontier scientists are exploring other features of life by asking new questions that go beyond the dominant paradigm. Their questions come from various frontier areas of science and medicine such as epigenetic heredity, bioelectromagnetics, homeopathy, and low dose bioeffects. The results of their investigations, which may be regarded as individual anomalies by the mainstream, may be taken together as evidence for the need of a bigger paradigm to accommodate them. Biology, it appears, may be entering a crisis.

Not only do these "anomalies" challenge our present view of life, but collectively they point to the necessity for a holistic view of life to complement the reductionistic view. Whereas conventional science maintains that biological information is stored and transferred via biomolecular structures such as DNA, the anomalies show that other informational signals not stored in chemical structures may elicit biological effects by possibly altering the subtle informational signals involved in biological regulation of the whole organism.

Major changes in science have never been brought about by isolated experimental findings, but by collective evidence. Thus, it is crucial for scientists who dare to venture into tributaries of the mainstream or uncharted terrain to come together to dialogue and share their data, to find that what may seem as isolated anomalies fit together to form the rudiments of an emerging paradigm. It is important to look at the problems of our science and the gaps in our knowledge. We must continually ask new questions, to never be satisfied with the old ones or the answers that have come to pass. Scientists must continually be motivated by the "mother" of all questions: what facets of nature remain undiscovered because what we consider to be theoretical certainties prevent the posing of new challenging questions?

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* In this regard, it is interesting to note that in Chinese, the character for "crisis" also means opportunity

** The Princeton Plasma Fusion physicists said of cold fusion, when it was first announced, "What would you do if you were working to develop a propeller airplane that did not yet fly and somebody else from outside the field suddenly invented a rocket ship?"(Mallowe, 1993). *[see the "shapist" vs the vibrational or frequency coding battle in psychophysiology of odor detection]*