

# The Physics of Complementary and Alternative Medicine

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## Summary

Much of Complementary and Alternative Medicine is non-scientific, violating many well established principles of physics and relying on anecdotal evidence of little scientific merit. In particular, no scientific basis exists for the notion of special vital forces or energy fields associated with living organisms. Medical journals should follow the lead of most scientific journals and not publish extraordinary claims without extraordinary evidence.

## Introduction

One of the primary assumptions within Complementary and Alternative Medicine (CAM) is that living things possess a special energy field, linked to the cosmos, which I will call the *bioenergetic field*. "Pure energy" is viewed as a biophysical substance separate from and superseding matter. Electromagnetic fields are presented as examples of pure energy and are identified with the bioenergetic field. Newtonian mechanistic, reductionistic physics is reported to be refuted by modern physics. Quantum physics is called upon to back the assertion that the universe is one continuous, interconnected whole of which human consciousness is a part, thus allowing the mind to control reality. While generally applied to human therapies, much of CAM has appears to have found its way into veterinary medicine (Schoen 2000).

A major theorist of CAM is Martha Rogers (1970, 1986, 1989, 1990), who has introduced what she calls *The Science of Unitary Human Beings*. In Rogers' words,

". . . energy fields are postulated to constitute the fundamental unit of the living and nonliving." [The field is] "a unifying concept and energy signifies the dynamical nature of the field. Energy fields are infinite and paradimensional; they are in continuous motion." (Rogers 1990, 30)

Following Rogers' lead, Joanne Stafantos, asserts that

"The principles of energy medicine originate in quantum physics. Bioenergetic medicine is the study of human and animal bodies as dynamic electromagnetic fields existing in an electromagnetic environment. . . . Based on Einstein's theories of quantum physics, these energetic concepts are being integrated into medicine for a comprehensive approach to disease diagnosis, prevention, and treatment." (Stafantos 1997, 227)

Another leading guru of the CAM movement is Deepak Chopra, the author of numerous best-sellers including *Ageless Body, Timeless Mind: The Quantum Alternative to Growing Old*. Here is a sample of Chopra's assertions (Chopra 1989, 1993):

- "The physical world is a creation of the observer."
- "The body is information and energy spanning the universe."
- "Thoughts and emotions create physical processes."
- "All of us are connected to patterns of intelligence that govern the cosmos."
- "Inside us is a field of non-change that creates who we really are."

Finally, psychiatrist Patricia Newton (1993) has argued that traditional healers "are able to tap that other realm of negative entropy - that superquantum velocity and frequency of electro-magnetic energy and bring them as conduits down to our level. It's not magic. It's not mumbo jumbo. You will see the dawn of the 21st century, the new medical quantum physics really distributing these energies and what they are doing."

In this paper, these claims are analyzed within the framework of established physics.

## **Substance Duality**

Most lay people believe that the universe is made of two kinds of stuff:

1. *Matter*, which includes the bodies of living organisms and the other material stuff of the universe. They have heard that matter is composed of particulate atoms, and associate material objects with notions of discreteness and scientific reductionism.
2. *Energy*, which is associated in the lay mind with spirit or soul. The common belief is that living things possess some special quality that makes them alive, an *élan vital*, or vital force, of living energy. CAM theorists often identify this bioenergetic field with

physical electromagnetic fields, which still appear mysterious to many more than a century after their discovery. These energy fields are associated with notions of continuity and holism that are said to oppose the discreteness and reductionism of “cold” physical science.

However, these beliefs do not reflect developments in either the physical or biological sciences of several centuries. Prior to twentieth century, most scientists held to the following picture: Energy and matter indeed were regarded as separate and distinct substances. On the other hand, while appearing continuous to the naked eye, matter was already understood to be composed of discrete, localized atoms. Light had been shown to be a form of electromagnetic wave, which was believed to result from the vibration of a continuous cosmic field, the aether. Electromagnetic waves were regarded as a form of pure energy. Gravity was thought to be a continuous action-at-a-distance field.

In the twentieth century, these views evolved and changed to the following: Energy and matter were recognized to be the same stuff, as signified by Einstein’s famous equation  $E = mc^2$ . The discrete nature of matter was fully confirmed, and energy was shown to occur, like matter, in discrete lumps called *quanta*. In fact, this was the discovery of Max Planck that triggered the development of quantum mechanics. Despite what the CAM theorists seem to think, quantum mechanics is about discreteness, not continuity.

The search for the continuous aether met with failure and the concept was discarded in the new physics or relativity and quantum theory. Indeed, no evidence has been found for any continuous medium in universe. Light is composed of particulate matter—*photons*. Fields are composed of discrete particles—*quanta*. The photon is the quantum of the electromagnetic field, which is, in effect, like a field of pebbles. The electron is the quantum of the electron field. Finally, general relativity explains gravity in terms of the curvature of space rather than as a continuous force field.

### **The Standard Model of Matter**

Material objects are made of atoms, which in turn are composed of nuclei and electrons. Nuclei are composed of protons and neutrons, which themselves are composed of

quarks. By the 1970s, the following picture of matter (and energy) had been strongly established in what is still called the *standard model*, but is now a fully-developed and highly successful theory. Three generations of quarks and leptons exist, as illustrated below:

|   |       |   |
|---|-------|---|
| u | c     | t |
| d | s     | b |
| e | $\mu$ |   |
| e | $\mu$ |   |

The top two rows are the quarks, and the bottom two rows are the leptons. Each column represents a “generation,” where the first generation encompasses the great bulk of familiar matter. The proton is composed of the three quark combination uud, while the neutron is the combination udd. These, along with the electron e, compose all the atoms of the chemical periodic table. The third row of particles are the neutrinos, which while not present in atoms are perhaps the most common particle in the universe. Each particle in the above table has an associated antiparticle.

## The Standard Model of Forces

The elementary particles that make up matter are only half the story. The standard model also tells us how these particles interact with one another to make up the more complex stuff that has evolved into stars, planets, and horses. In the standard model, forces result from the exchange of particles called *gauge bosons*:

electromagnetism --> photon  
 strong nuclear --> gluons (8)  
 weak nuclear --> weak bosons (4)  
 gravity --> graviton

(I have included gravity, although no quantum theory of gravity yet exists and it is not normally considered part of the standard model). While these “force particles” are described by quantum fields in the theory, no continuous medium, such as the aether, is involved.

## Quantum Fields

Quantum fields are strictly theoretical objects, like the density field that describes average behavior of particulate matter. They do not describe a continuous medium, such as an aether, pervading space. Since every particle is the quantum of a quantum field, no fields exist independent of particles. Furthermore, quanta do not act instantaneously over space. Their effects propagate no faster than the speed of light. That is, quantum fields are not holistic and no basis in modern quantum physics exists for the claims made by CAM theorists—despite their unbridled use of the term “quantum.”

## Life and Mind

All living organisms are composed of the same quarks and electrons as compose a rock or a river. They are acted on by the same forces. Physicists have been able to measure effects of the electromagnetic force to one part in a billion, but see not the slightest hint of special vital or psychic forces. No evidence has ever been found for any unique fields or radiation associated with living organisms. Life and mind can be understood as emergent properties of matter. Brain imaging and other neuroscience provide strong evidence for localized, material sources of thoughts and emotions.

## The Unconscious Quantum

Quantum mechanics is said to provide a basis for a mind-matter connection. This notion arises from the fact that, in quantum mechanics, the act of observation interferes with what is being observed, as expressed by the *Heisenberg uncertainty principle*. Chopra and others claim that reality is thus determined by consciousness. But mind and consciousness are not independent of matter. The brain is wired to the body, but not to other bodies. Nothing in quantum phenomena or quantum theory requires the introduction of non-material or holistic elements.

## Has Modern Physics Shown that Classical, Reductionist Physics is "Wrong?"

Most physics taught in classrooms is still classical physics. Modern physics is built on a base of classical physics and is still completely materialistic and reductionistic. Modern technology, biology, and medicine still rely heavily on classical physics. The claim that a paradigm-shift occurred with modern physics is debatable. In fact, the last major paradigm-shift in physics occurred when Newton's physics replaced Aristotle's. As Nobel physicist Steven Weinberg (1998) has explained:

"Revolutions in science seem to fit Kuhn's description only to the extent that they mark a shift in understanding some aspect of nature from pre-science to modern science. The birth of Newtonian physics was a mega-paradigm shift, but nothing that has happened in our understanding of motion since—not the transition from Newtonian to Einsteinian mechanics, or from classical to quantum physics—fits Kuhn's description of a paradigm shift. "

## What Constitutes Evidence?

Any claim that implies the overthrow of well-established scientific principles has an extraordinary burden of proof. Since so much rubbish is out there, the only rational and practical policy is to ignore such claims until extraordinary evidence is presented. Anecdotal evidence is ordinary, since people can be easily tricked or self-deluded. The placebo effect is powerful and difficult to eliminate even in the best controlled experiments. A single experiment, even peer-reviewed, is never enough. Multiple independent replications are essential.

Let me list some *ordinary claims* that, if true, would violate no established science:

## Ordinary Claims

- Some herbs may have some medical benefits.
- Relaxation or meditation may have some medical benefit.
- Chiropractic treatments may ease back pain.
- A patient's state of mind can affect his or her health.
- Treating the "whole patient" may be better than just treating his or her parts.

- High frequency electromagnetic radiation has harmful effects.

On the other hand, consider the following examples of *extraordinary claims* that, if true, would violate well-established science:

### Extraordinary Claims

- Homeopathic remedies can have any effect at all.
- Meditation tunes you into the cosmic field of mind.
- Chiropractic treatments can cure a wide range of illnesses.
- Mind can overcome established physical law.
- You can improve a person's health by manipulating his or her vital energies.
- Acupuncture is more than a placebo effect.
- Low frequency electromagnetic radiation has harmful effects.
- Placing magnets on the body will have any effect at all.

### Publication Thresholds

Based on the standards of physics, where extraordinary phenomena are often observed, the threshold for publication of extraordinary claims in medical journals should be raised considerably. Most journals in medicine, psychology, and pharmacology, as well as parapsychology, seem to allow publication at the  $p = 0.05$  significance level, usually misrepresenting this as the "probability for the result being due to chance." The precise definition of the p-value is as follows: If the null hypothesis is correct, then the reported effect or a greater one would occur as a statistical artifact on the average a fraction  $p$  times. That is, the p-value makes no statement about the likelihood that the reported effect is real. It only makes a statement about the expected frequency that the effect would result from chance when the effect is not real.

Thus, according to statistical theory, when a reported effect is said to have a p-value of 0.05, then in every 20 replications of the experiment we can expect one, on average, to be a statistical artifact. Since few experiments showing null effects are published, it is easy to imagine 19 of these left in the "filedrawer."

For example, the significance of a highly touted study on the medical benefit of prayer was  $p = 0.04$ . One might ask how many negative experiments were not published? Perhaps 25 or more and only the one that gave an effect at this level of significance was reported.

The field of physics is rife with examples of reported extraordinary effects with  $p$ -values much lower than .05 that failed to be replicated and never became a part of established knowledge. The accepted criterion in most physics journals is  $p = 10^{-4}$ . That is, an effect is published when only one in 10,000 experiments or more would produce the observation as a statistical artifact. A much stricter threshold than  $p = 0.05$  should be used for extraordinary claims in all branches of science. Ordinary claims, consistent with existing science, can be published with weaker significance, on the understanding that these reports should do more good than harm. Great harm can come from claiming a great medical breakthrough that is nothing more than a statistical fluke.

## Conclusions

Most CAM is non-scientific. If it were scientific, it would be neither complementary or alternative but part of the mainstream. Energy therapies and other forms of CAM are based on the ancient notion that living matter possesses some special vital force or energy that is separate from matter. Today this energy is mistakenly associated with electromagnetic or quantum fields. However, no evidence for any special vital forces, energies, or fields has ever been found. Modern physics has shown that energy and matter are the same entity and finds no evidence for continuous fields. The quantum fields of theoretical physics are directly connected, one-to-one, to particles, the quanta of the fields. A consistent picture of elementary particles and forces that successfully describes all current observations exists within the framework of the standard model.

Living matter is composed of the same particles acted on by the same forces as non-living matter. Quantum mechanics provides no basis for paranormal or holistic claims while all of modern physics remains totally materialistic and reductionistic. No mega-paradigm shift occurred in the twentieth century comparable to that of Newton in the seventeenth century.

Reports of extraordinary claims should not be published unless the evidence is extraordinary. The violation of established physical law is sufficient to ignore such claims until extraordinary evidence is presented.

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