

ELF Effects: Paradigm Shift or Fabric Rip?

I was surprised to see *Currents of Death*, by Paul Brodeur, and *Cross Currents*, by Robert Becker, reviewed by Indira Nair in *PHYSICS TODAY* (December 1990, page 79). In my library those books sit next to the works of Immanuel Velikovsky, J. B. Rhine and the latest on flying saucers.

Becker, an MD schooled in physics, he says, by one elementary college course, attributes all the ills of mankind—from AIDS through depression on to zymosis—to the minute electromagnetic fields in our environment. Similar views are expressed by Brodeur, whose science education seems to be even less extensive. Nair, whose accomplishments in science I consider no greater than Brodeur's, takes much the same line, praising the books of Becker and Brodeur by faint damnation.

In the course of presenting her own version of the Becker–Brodeur thesis, Nair wildly misstates the reasons why good scientists hold these very weak 60-Hz fields harmless. In fact, such fields are considered harmless because their effects on the cellular level are very, very much smaller than kT and thermal noise. And over larger regions, the fields are very, very much smaller than other, indigenous noise fields in the body.

No one has been able to reproduce the “cellular level” experiments that Nair claims have demonstrated the existence of biological effects of such weak fields. The epidemiological studies that she says link weak fields with leukemia and other cancers are neither statistically significant nor free from systematic biases—and there are many negative studies.

I find it ironic that this review is in the same issue where Philip Anderson (page 9) says, “Results that rip the fabric [of science] to shreds must be expected to be almost invariably wrong.” But Nair and her colleagues explain the “rip in the fabric” by Becker, Brodeur and herself as a “paradigm shift,” thus kidnapping Thomas Kuhn's interesting concept to justify illegitimate science.

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BECKER REPLIES: It is evident that Robert K. Adair's rejection of any biological effects from low-level electromagnetic fields rests entirely on the outmoded concept that kT must be exceeded for such effects to occur. This concept in turn rests upon the also outmoded biological concept that living things are simply chemical machines all of whose functions result from chemical reactions in aqueous medium. The primary events in detection of light by the retina and in photosynthesis have for a long time clearly indicated that this is not so. Over the past few decades, additional capabilities of living things have been discovered that also violate the kT concept. These include microcrystalline magnetite deposits existing in conjunction with elements of the central nervous system that provide a sensing ability for very weak magnetic fields, and the sensitivity of the retina–pineal system to diurnal fluctuations in the geomagnetic field. At the cellular level, the evidence that extremely-low-frequency fields far below kT influence the kinetics of the cell cycle is overwhelming. Many thousands of humans with bone fractures that have failed to heal have

had the healing process “restarted” by exposure to pulsed magnetic fields or low-level electrical currents, both also well below kT . These and other changes in biological knowledge are discussed and referenced in my book *Cross Currents*. Apparently Adair did not bother to read it.

Clearly biological organisms are more than chemical machines, and the paradigm shift referred to by Indira Nair is in biology, not in physics or engineering. The new biological paradigm is far richer than the old and offers great opportunities for medical therapies as well as cautions for our ever expanding use of electromagnetic energy. Both urgently require full exploration. I regret that Adair apparently feels threatened by these changes, but I reject his arrogance in requiring that living organisms conform to his concept of reality. We have not “kidnapped” Thomas Kuhn’s concepts. Adair’s invocation of dogma is the inevitable counterpoint of all paradigm shifts.

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